# INSTALLATION RESTORATION PROGRAM (IRP) SITE INVESTIGATION FOR IRP SITE No. 1

# VOLUME I

## 101st AIR CONTROL SQUADRON
## MASSACHUSETTS AIR NATIONAL GUARD
## WORCESTER AIR NATIONAL GUARD STATION
## WORCESTER, MASSACHUSETTS

**JANUARY 1995**

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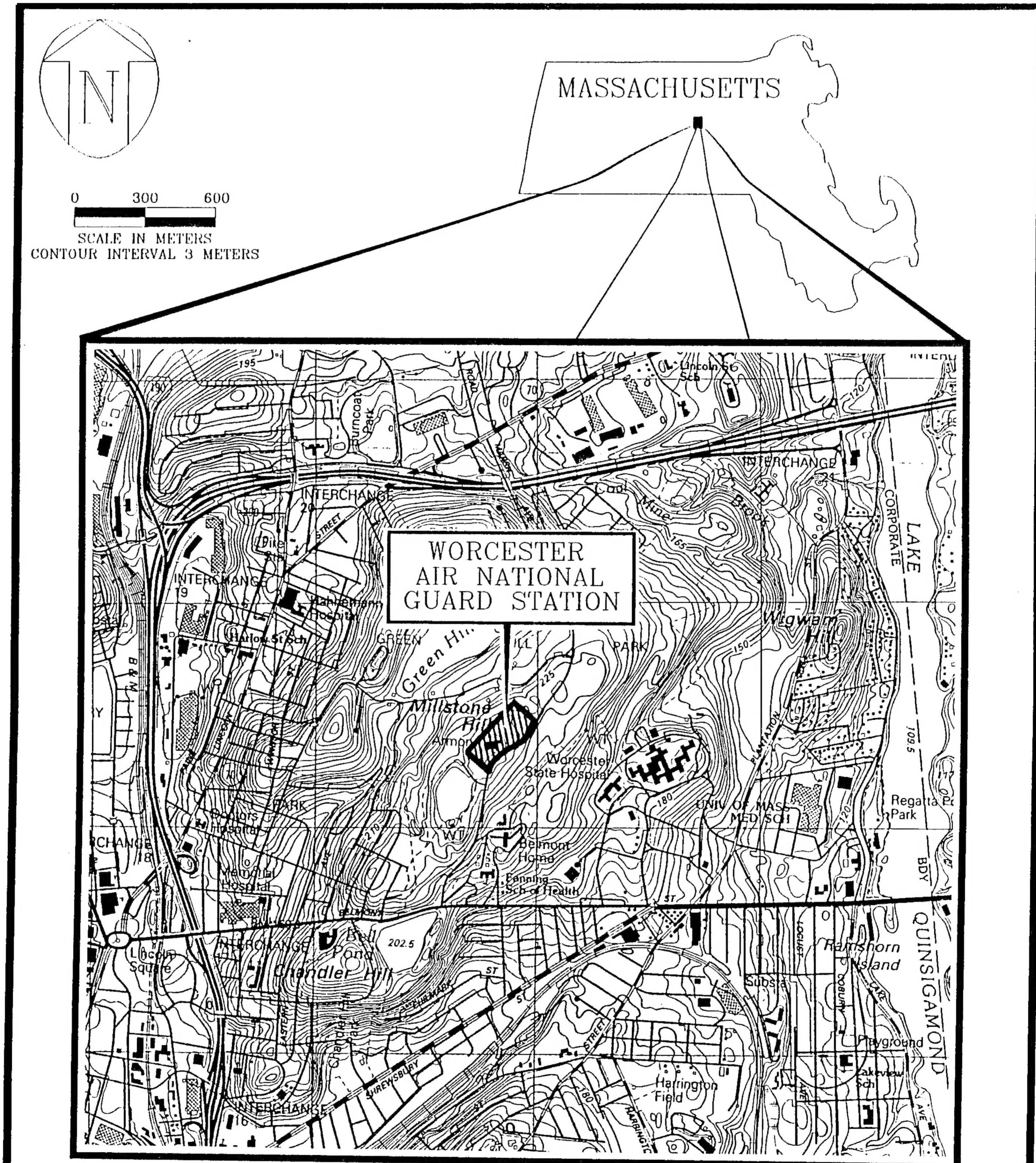


SOURCE: USGS 7.5 MIN. QUAD WORCESTER NORTH, 1983.

| INSIDE FRONT COVER | STATE LOCATION MAP OF WORCESTER AIR NATIONAL GUARD STATION<br>Massachusetts Air National Guard<br>Worcester, Massachusetts | OPTECH<br>OPERATIONAL TECHNOLOGIES CORPORATION |
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13. ABSTRACT *(Maximum 200 words)*

A Site Investigation (SI) was conducted at the Old Embankment/Vicinity of the old Waste Holding Area at Installation Restoration Program (IRP) Site No. 1 located at the 101st Air Control Squadron (ACS) and the 212th Engineering Installation Squadron (EIS), Massachusetts Air National Guard (MASS ANG), Worcestor, MA. Volatile Organic Compounds (VOC) concentrations detected did not exceed Massachusetts Soil Standards and PCBs were not detected. However, semivolatile organic compound, metals, and petroleum hydrocarbons were detected above reportable concentrations. Additional background sampling and a Remedial Investigation / Feasibility Study (RI/FS) were recommended to determine the nature and extent of contamination.


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**MASSACHUSETTS AIR NATIONAL GUARD**
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**WORCESTER, MASSACHUSETTS**

**JANUARY 1995**

***Prepared For***

**AIR NATIONAL GUARD READINESS CENTER**
**ANDREWS AFB, MARYLAND**

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# TABLE OF CONTENTS

## VOLUME I

# TABLE OF CONTENTS (Continued)

## VOLUME I

# TABLE OF CONTENTS (Concluded)

## VOLUME II

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# LIST OF FIGURES

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# LIST OF ACRONYMS

| | |
|---|---|
| ACS | Air Control Squadron |
| AGE | Aerospace Ground Equipment |
| ANG | Air National Guard |
| ANGRC/CEVR | Air National Guard Readiness Center/Installation Restoration Branch |
| ANGS | Air National Guard Station |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| ASTM | American Society of Testing and Materials |
| ATHA | Ambient Temperature Headspace Analysis |
| BH | Borehole |
| BLS | Below Land Surface |
| BTEX | Benzene, Toluene, Ethylbenzene, and Xylenes |
| C | Centigrade |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| cm/sec | Centimeters per second |
| DD | Decision Document |
| DERP | Defense Environmental Restoration Program |
| DL | Detection Limit |
| DoD | Department of Defense |
| DQO | Data Quality Objective |
| DRMO | Defense Reutilization and Marketing Office |
| EIS | Engineering Installation Squadron |
| EO | Executive Order |
| F | Fahrenheit |
| FS | Feasibility Study |
| Ft | Feet |
| GC | Gas Chromatography |
| gpm | Gallons per minute |
| HAS | Hazard Assessment Score |
| HRS | Hazard Ranking System |
| HSA | Hollow-Stem Auger |
| ID | Interior Diameter |
| IRP | Installation Restoration Program |
| LTM | Long-Term Monitoring |
| MADEP | Massachusetts Department of Environmental Protection |
| MASS ANG | Massachusetts Air National Guard |
| MCP | Massachusetts Contingency Plan |
| MEK | Methyl Ethyl Ketone |
| mg/kg | Milligrams per kilogram |
| MSL | Mean sea level |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| MTBE | Methyl-t-butyl-ether |
| NFA | No Further Action |
| OpTech | Operational Technologies Corporation |

# LIST OF ACRONYMS (Concluded)

| | |
|---|---|
| OWS | Oil/water separator |
| PA | Preliminary Assessment |
| PCB | Polychlorinated Biphenyl |
| PID | Photoionization Detector |
| PM | Project Manager |
| ppb | Parts per billion |
| PPE | Personal Protective Equipment |
| ppm | Parts per million |
| QA/QC | Quality Assurance/Quality Control |
| RA | Remedial Action |
| RD | Remedial Design |
| Revet | Revet Environmental & Analytical Laboratories, Inc. |
| RI/FS | Remedial Investigation/Feasibility Study |
| RM | Remedial Measure |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |
| SI | Site Investigation |
| SM | Site Manager |
| SOP | Standard Operating Procedure |
| SOW | Statement Of Work |
| SVOC | Semivolatile Organic Compounds |
| TDS | Technical Drilling Services, Inc. |
| TPH | Total Petroleum Hydrocarbons |
| $\mu$g/kg | Micrograms per kilogram |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |
| UST | Underground Storage Tank |
| UTA | Unit Training Assembly |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compounds |
| WP | Work Plan |

# EXECUTIVE SUMMARY

## 1.0 INTRODUCTION

A Site Investigation (SI) was conducted at the Old Embankment/Vicinity of the Old Waste Holding Area at Installation Restoration Program (IRP) Site No. 1 (also referred to as the site), located at the 101st Air Control Squadron (ACS) and the 212th Engineering Installation Squadron (EIS), Massachusetts Air National Guard (MASS ANG), Worcester, Massachusetts. The site was identified in the IRP Preliminary Assessment (PA) for the Station, conducted by Science & Technology, Inc. The field investigation conducted by Operational Technologies Corporation (OpTech) at the 212th EIS commenced on 15 November 1993 and was completed on 19 November 1993.

## 2.0 OTHER INVESTIGATIONS

A PA of the 101st ACS and 212th EIS, Worcester ANGS, was conducted by Science & Technology, Inc., in May 1990 and published in February 1991. Information obtained through interviews, review of Station records, and field observations resulted in the identification of one potentially contaminated disposal and/or spill site. This site was identified as IRP Site No. 1 (Old Embankment/Vicinity of the Old Waste Holding Area).

In 1993, as part of a national ANG program, all but two underground storage tanks (USTs) at the station were removed under the direction of Wadleigh Environmental of Boston, Massachusetts. The existing diesel, MOGAS, waste oil, waste JP-5, two #2 fuel oil USTs, and two oil/water separators (OWS) were removed. During removal of the OWS north of Building 1, it was discovered to be a dry well. The dry well was removed with no laboratory analysis performed on surrounding soils. The OWS west of Building 2 was replaced with a new OWS. Contamination was detected during removal in the 10,000-gallon #2 fuel oil UST north of Building 1. The second #2 fuel oil, tank north of Building 2, was punctured by the contractor during removal. An Immediate Response Action Plan (IRA), pursuant to the Massachusetts Contingency Plan (MCP), was filed by the contractor with the Massachusetts Department of Environmental Quality (MADEP) for both #2 fuel oil tanks north of Buildings 1 and 2. The objective of the IRA was to remove the two tanks and to properly manage any overtly contaminated soil encountered during the excavation. Based on the actions taken, the IRA was completed (IRA Completion Report, 1994).

## 3.0 OLD EMBANKMENT/VICINITY OF THE OLD WASTE HOLDING AREA

The southern boundary of the site extends from the northeast corner of Building 3 (Storage Building) to the northwest corner of Building 2, the Aerospace Ground Equipment (AGE) Shop. The site extends to the north approximately 30 feet beyond the northwest perimeter fence. The north boundary of the site parallels the fence line. The Old Embankment extended from the northwest corner of Building 2 to the northeast corner of Building 3 until the 1970s and early 1980s, at which time the low area located between the embankment and current fence line was filled in with construction debris. The site extends to the base of the current embankment which parallels the northern fence line. A portion of the site lying outside of the fence line has been extended approximately 40 feet to the southwest to include a portion of the current embankment.

## 3.1 INVESTIGATIVE FINDINGS

### 3.1.1 Soil Contamination

Soil samples were submitted for analysis of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), priority pollutant metals, total petroleum hydrocarbons (TPH), and polychlorinated biphenyls (PCBs). Of the 21 soil samples analyzed, five samples had detectable levels of VOCs. None of the 21 samples analyzed for VOCs exceeded Massachusetts Soil Standards. SVOCs were detected in 15 of the 21 soil samples submitted for analysis. Three compounds (benzo(b)fluoranthene, benzo(a)pyrene, and 2-methylnaphthalene) were detected above Massachusetts Soil Standards.

Metals were detected in all soil samples analyzed, and 13 samples contained levels above Reportable Concentrations. Ten of the 13 target metals were detected, and three (arsenic, beryllium and lead) exceeded Massachusetts Soil Standards. Background metal concentrations were not considered reliable due to the location of one of the background soil borings near a previously unidentified source of contamination, the underground storage tanks. However, according to information contained in Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States (Shacklette and Boerngen, 1984), arsenic and lead detected in analyzed soil samples showed generally higher levels than those normally found in the central Massachusetts area, and beryllium levels were within or lower than the range normally found in that area.

PCBs were not detected in any of the 21 soil samples submitted.

TPH was detected in eleven of the 21 soil samples submitted for analysis. Only two samples, one from 01-008BH and another from 01-012BH, presented concentrations exceeding Massachusetts Soil Standards.

## 4.0 CONCLUSIONS

VOC concentrations detected in soil samples collected during the SI did not exceed Massachusetts Soil Standards, and PCBs were not detected in any of the samples analyzed. However, SVOCs, metals, and TPH were detected above Reportable Concentrations in several soil samples submitted for analysis. SVOCs exceeding Reportable Concentrations were detected at borings 01-003BH, 01-005BH, and 01-008BH. Metals exceeding Reportable Concentrations were detected at borings 01-001BH through 01-006BH, 01-008BH, 01-009BH, and 01-015BH. TPH contamination exceeding Reportable Concentrations was detected at borings 01-008BH and 01-012BH. The extent of SVOCs, metals, and TPH contamination was not determined during the SI.

## 5.0 RECOMMENDATIONS

Based on the results of the SI conducted, the following recommendations are presented:

1. Perform additional background sampling to better characterize existing concentration of metals in soil at the site. Background borings 01-001BH and 01-002BH exceeded the MADEP Reportable Concentrations for arsenic. Boring 01-002BH was located in an area where it may have been affected by contamination from the USTs.

2. Conduct a Remedial Investigation/Feasibility Study (RI/FS) at the site. SVOC, metals and TPH contamination is present at the site, and the nature and extent has not been determined.

3. Determine the nature and extent of contamination at the USTs and oil/water separator areas. Contamination has been reported to be present in the area of the oil/water separator/dry well.

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# SECTION 1.0 INTRODUCTION

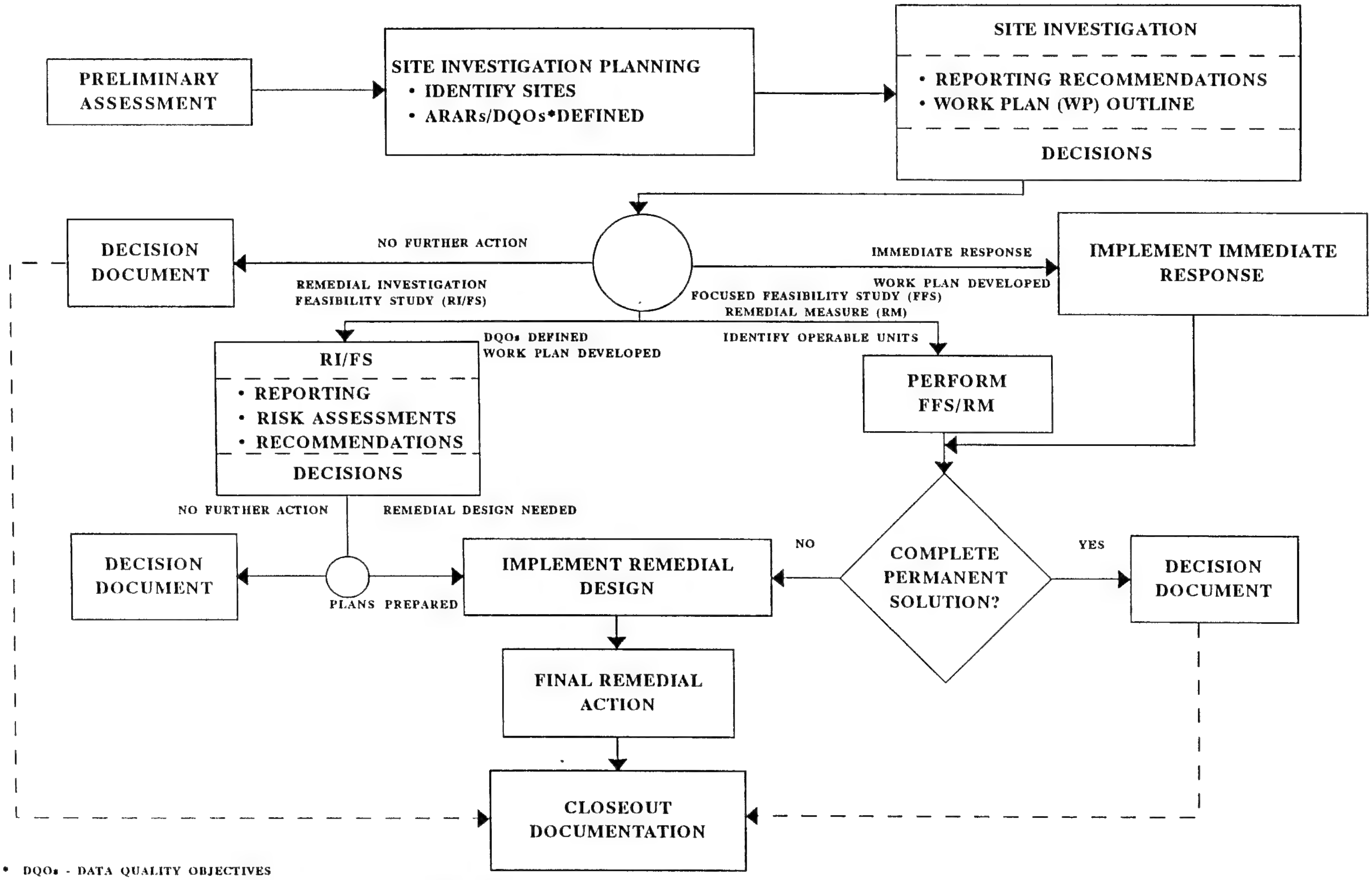
This Site Investigation (SI) report presents the results of investigation activities conducted at the 101st Air Control Squadron (ACS) and the 212th Engineering Installation Squadron (EIS), Worcester Air National Guard Station (ANGS), Worcester, Massachusetts (Inside Front Cover Figure). A Preliminary Assessment (PA) of the 101st ACS and the 212th EIS, Worcester ANGS, was conducted by Science & Technology, Inc. Information obtained through interviews, review of Station records, and field observations resulted in the identification of one potentially contaminated disposal and/or spill site. This site was identified as Installation Restoration Program (IRP) Site No. 1 (Old Embankment/Vicinity of the Old Waste Holding Area) and was recommended for further investigation under the IRP.

The Air National Guard Readiness Center/Installation Restoration Branch (ANGRC/CEVR) authorized Operational Technologies Corporation (OpTech) to prepare an SI Work Plan and conduct the SI at the Old Embankment/Vicinity of the Old Waste Holding Area. This investigation was conducted as outlined in the SI Work Plan submitted to the ANGRC/CEVR and the Massachusetts Department of Environmental Protection (MADEP) in April 1993, and approved in July 1993.

## 1.1 INSTALLATION RESTORATION PROGRAM

The Defense Environmental Restoration Program (DERP) was established in 1984 to promote and coordinate efforts for the evaluation and cleanup of contamination at Department of Defense (DoD) installations. On 23 January 1987, Presidential Executive Order (EO) 12580 assigned specific responsibility to the Secretary of Defense for carrying out DERP within the overall framework of the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. The IRP was established under DERP to identify, investigate, and clean up contamination at DoD installations. The IRP focused on cleanup of contamination associated with past DoD activities to ensure that threats to public health were minimized and natural resources were restored for future use. Within the Air National Guard, ANGRC/CEVR manages the IRP.

The IRP is divided into six phases as illustrated in Figure 1.1, and defined and described in the following subsections.




* DQOs - DATA QUALITY OBJECTIVES
ARARS - APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

FIGURE 1.1

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FLOW OF INSTALLATION RESTORATION PROGRAM TASKS
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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### 1.1.1 Preliminary Assessment

The PA process consists of personnel interviews, a records search, and a site visit designed to identify and evaluate past disposal and/or spill sites that might pose a potential and/or actual hazard to public health, public welfare, or the environment. Previously undocumented information is obtained through the interview process. The records search focuses on obtaining useful information from aerial photographs; installation plans; facility inventory documents; lists of hazardous materials used; subcontractor reports; correspondence; Material Safety Data Sheets; Federal/State agency scientific reports and statistics; Federal administrative documents; Federal/State records on endangered species, threatened species, and critical habitats; documents from local government offices; and numerous standard reference sources.

### 1.1.2 Site Investigation

The SI phase consists of field activities designed to confirm the presence or absence of contamination at the potential sites identified in the PA or during non-related IRP investigations, and to provide data needed to reach a decision point for the site. The activities undertaken during the SI generally fall into three distinct categories: screening, confirmation, and optional activities.

*Screening Activities*

Screening activities are conducted prior to drilling activities to gather preliminary data on each site. Screening activities may include the use of such tools as a magnetometer survey to locate underground lines, tanks, and utilities; soil gas surveys for developing the optimum number and location of soil borings needed to delineate soil contamination, and to be used as a guide in the selection of monitoring well locations; or the installation of a piezometer network in order to determine groundwater flow direction prior to installation of any groundwater monitoring wells.

*Confirmation Activities*

Confirmation activities include the installation of soil borings and/or monitoring wells; specific media sampling; and laboratory analysis to confirm either the presence or the absence of contamination, levels of contamination, and the potential for contaminant migration. Information obtained during the subsurface investigation is also utilized to define the installation and site hydrology, geology, and soil characteristics.

*Optional Activities*

Optional activities are used if additional data are needed to reach a decision point for a site, such as no further IRP action is warranted, prompt removal of contaminants is necessitated, or further IRP work is required. Optional activities may include increasing the number of soil gas sampling points or the number of soil borings and/or monitoring wells to be drilled.

The general approach for the design of the SI activities is to sequence the field activities so that data are acquired and used as the field investigation progresses. This is done in order to determine the absence or presence of contamination in a relatively short period of time, optimize data collection and data quality, and to keep costs to a minimum. Information, data, and analytical results obtained from the SI field investigation will support the selection of one of the following decisions:

**No Further Action (NFA)** – Investigation did not indicate harmful levels of contamination that pose a significant threat to human health or the environment. Therefore, no further IRP action is warranted and a Decision Document (DD) will be prepared to close out the site.

**Immediate cleanup/remedial activities** – Investigation indicates that the site poses an immediate threat to public health or the environment. Therefore, prompt removal of contaminants or measures to reduce contaminant levels to an acceptable limit is warranted.

**Remedial Investigation/Feasibility Study (RI/FS)** – Investigation indicates further IRP work is required and the next phase of the IRP needs to be implemented. The RI is described more fully in the following subsection.

### 1.1.3 Remedial Investigation

The objectives of the RI are to determine the nature and extent of contamination at a site, determine the nature and extent of the threat to human health and the environment, and to provide a basis for determining the types of response actions to be considered (decision document, feasibility study, remedial design, remedial action).

The RI consists of field activities designed to quantify and identify the potential contaminant, the extent of the contaminant plume, and the pathways of contaminant migration. Field activities may include the installation of soil borings and/or monitoring wells, and the collection and analysis of water, soil, and/or sediment samples. Careful documentation and quality control procedures in accordance with CERCLA/SARA guidelines ensure the validity of data. Hydrogeologic studies are conducted to determine the underlying strata, groundwater flow rates, and direction of contaminant migration.

A baseline risk assessment may be conducted which provides an evaluation of the potential threat to human health in the absence of remedial action. The assessment provides the basis for determining whether remedial action is necessary, justification for performing remedial actions, and what imminent and substantial endangerment to public health or the environment exists.

### 1.1.4 Feasibility Study

Based on results of the RI, the baseline risk assessment, and a review of State and Federal regulatory requirements, an FS will be prepared to develop, screen, and evaluate alternatives for remediation of groundwater and/or soil contamination at the subject sites. The overall objective of the FS is to provide information necessary for remedial alternatives development. The FS is conducted to support selection of a remedy that is: protective of human health and the environment; attains applicable or relevant and appropriate requirements (ARARs); satisfies the preference for treatment that significantly and permanently reduces toxicity, mobility, or volume of hazardous constituents as a principal element; and is cost-effective.

Activities associated with the FS include the following:

- Development of alternatives;
- Preliminary screening of remedial alternatives;
- Detailed analysis of alternatives;
- Comparative analysis of alternatives; and
- The creation of an FS report.

The end result of the FS is the selection of the most appropriate remedial action with concurrence by State and/or Federal regulatory agencies.

### 1.1.5 Remedial Design

The remedial design (RD) involves formulation and approval of the engineering designs required to implement the selected remedial action identified in the FS.

### 1.1.6 Remedial Action

The remedial action (RA) is the actual implementation of the remedial alternative. It refers to the accomplishment of measures to eliminate the hazard or, at a minimum, reduce it to an acceptable limit. Covering a landfill with an impermeable cap, pumping and treating contaminated groundwater, installing a new water distribution system, and *in-situ* biodegradation of contaminated soils are examples of remedial measures that might be selected. In some cases, after the RAs have been completed, a long-term monitoring (LTM) system may be installed as a precautionary measure to detect contaminant migration or to document the efficiency of remediation.

# SECTION 2.0 FACILITY BACKGROUND

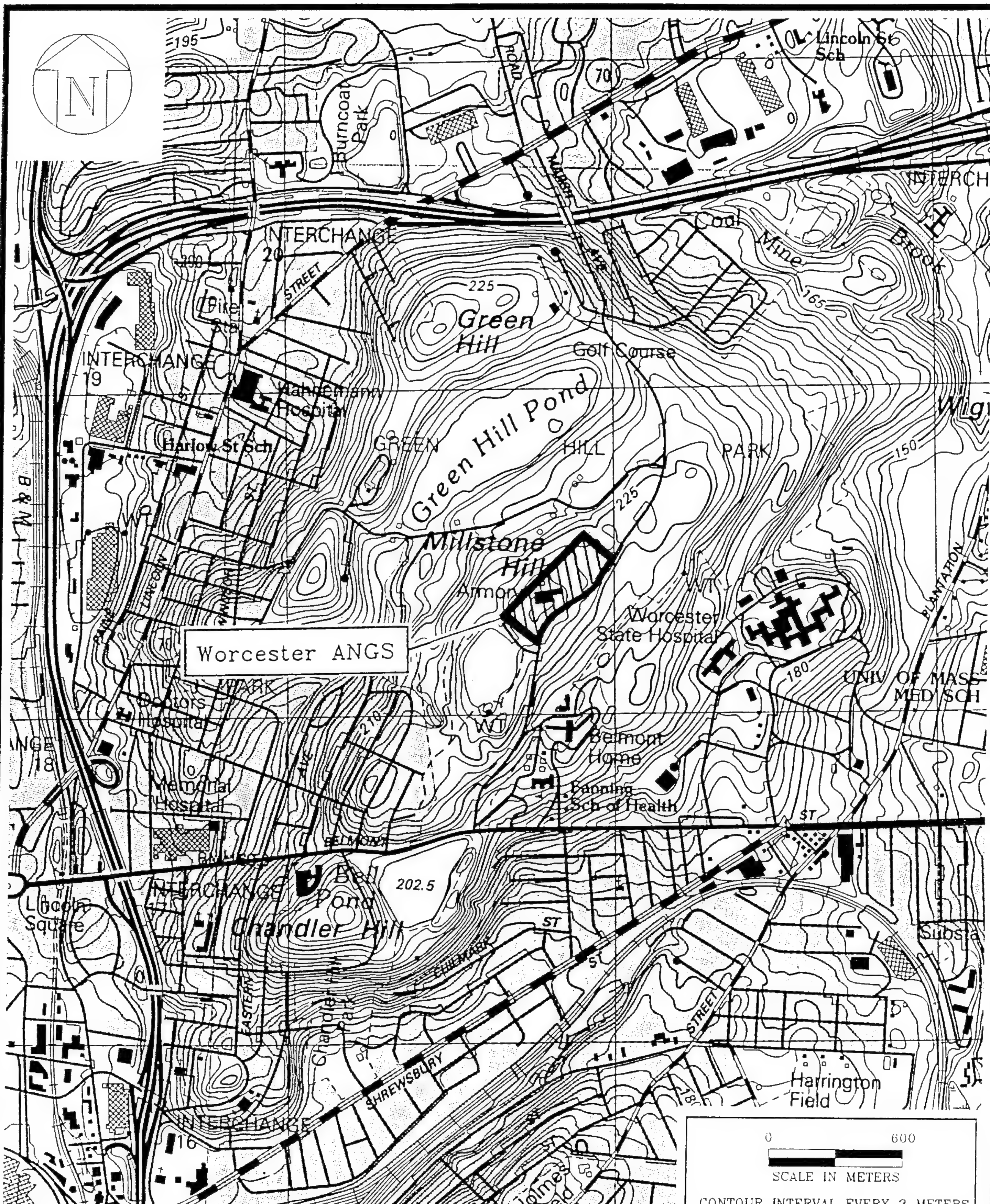
Worcester ANGS is located within the City and County of Worcester, Massachusetts. The Station occupies approximately seven acres of land along Skyline Drive, north of State Route 9 and has three permanent buildings. Building 1 is the main facility (Headquarters) which houses both the 101st ACS and the 212th EIS and each of their vehicle maintenance operations. Building 2 is the Aerospace Ground Equipment (AGE) Shop, and Building 3 is the 212th EIS storage facility. Figure 2.1 shows the surrounding area and boundaries of the Station.

Worcester ANGS has a normal full-time working population of approximately 63 people. The Station serves as a site for Unit Training Assembly (UTA) which meets one weekend per month. During the UTA weekend, the Station population reaches approximately 433.

## 2.1 FACILITY HISTORY

Unimproved property was leased in February 1956 for the construction of the Worcester ANGS. After the completion of the main building in 1957, operations began for both the 101st ACS host unit and the 212th EIS tenant unit.

The 101st ACS (recently redesignated from the 101st Tactical Control Squadron) moved from the Worcester Airport in 1957 and was originally organized as the 101st Aircraft Control and Warning Squadron. Their mission is to provide administrative and operational control of a 407L Control and Reporting Post. This encompasses the use of radar and communications and control facilities utilizing radio relay, high frequency, single side band, and satellite communications to support Tactical Air Operations. While their mission has not significantly changed over the years, technological advancements have improved their mission capabilities. The 212th EIS was originally organized as the 601st Signal Light Construction Company in 1947. After several redesignations, the 212th EIS was relocated to the Worcester ANGS from the Grove Street Armory in 1957. Their mission is to mobilize and deploy authorized resources and supporting assets to accomplish the engineering, installation, reconstruction, replacement, and upgrading of communications/computer systems. Their mission has not changed significantly since it was originally organized.




SOURCE: USGS 7.5 MIN. QUAD WORCESTER NORTH, 1983

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| FIGURE 2.1<br>WORC4-1L | LOCATION MAP<br>101st ACS and 212th EIS<br>Worcester Air National Guard Station<br>Worcester, Massachusetts | OPTECH<br>OPERATIONAL TECHNOLOGIES CORPORATION<br>JANUARY 1995 |

### 2.1.1 Adjacent Land Use

The Station is located on top of Millstone Hill and is completely surrounded by city park land. The municipal park includes a golf course located approximately 1,000 feet north of the Station, ponds and recreational areas to the northwest and west, and undeveloped woodlands to the southwest, northeast, and east. The Worcester State Hospital is located approximately 1,500 feet east of the Station, the Belmont Home and Fanning School of Health are located approximately 1,000 feet south of the Station. Developed residential and small business areas are located from 1,500 feet to 3,500 feet to the west, north, and south of the Station (see Figure 2.1).

### 2.1.2 Waste Disposal Practices

Mission support activities required the storage, use, and disposal of hazardous materials such as oils, hydraulic fluids, solvents, and fuels (diesel, MOGAS, JP-4, and JP-5). The largest use of these materials, and consequently the largest generator of waste, is for vehicle and AGE maintenance. From the late 1960s to 1981, small quantities of waste oil, solvents and fuels were poured along the northwest perimeter fence as a means of weed control. This area is included in IRP Site No. 1 and is described in Subsection 2.2.2. Currently, hazardous wastes are collected and stored until transported and disposed of off-site by a contractor or through turning in to the Defense Reutilization and Marketing Office (DRMO).

Potable water is supplied to the Station by the City of Worcester Department of Public Works, and wastewater is treated at the Upper Blackstone Valley Regional Treatment Plant. Currently, one oil/water separator (OWS) is used to mitigate the discharge of petroleum residues from the Vehicle Maintenance Shop and the AGE Shop to a wastewater pump station that discharges to the sanitary sewer. A second oil/water separator, removed in 1993, was located immediately north of Building 1. Upon removal of this oil/water separator, it was determined to be a dry well and not an oil/water separator system.

### 2.1.3 Previous Investigations

A PA of the 101st ACS and the 212th EIS, Worcester ANGS, was conducted by Science & Technology, Inc., in May 1990 and published in February 1991. Information obtained through interviews, review of Station records, and field observations resulted in the identification of one potentially contaminated disposal and/or spill site. This site is identified as IRP Site No. 1 (Old Embankment/Vicinity of the Old Waste Holding Area). IRP Site No. 1 was subjected to four different waste handling or disposal activities which included pouring wastes along the northwest

perimeter fence for weed control, spillage from waste oil storage, fuel spills in the generator storage area, and waste oil disposal in the storm sewer. Potential contaminants at the site include waste oil, organic solvents (including PD-680), and fuels (diesel, MOGAS, JP-4, and JP-5). The actual quantity of releases at the site is unknown.

Under the IRP, at the time of the PA, when sufficient information was available, sites were numerically scored and assigned a Hazard Assessment Score (HAS) using the United States Environmental Protection Agency Hazard Ranking System (HRS). This system was established to set priorities for taking further action at sites based upon information gathered during the PA phase of the IRP. It was determined at this site that a potential for contamination and the migration of the contaminants exists.

## 2.2 SITE DESCRIPTION

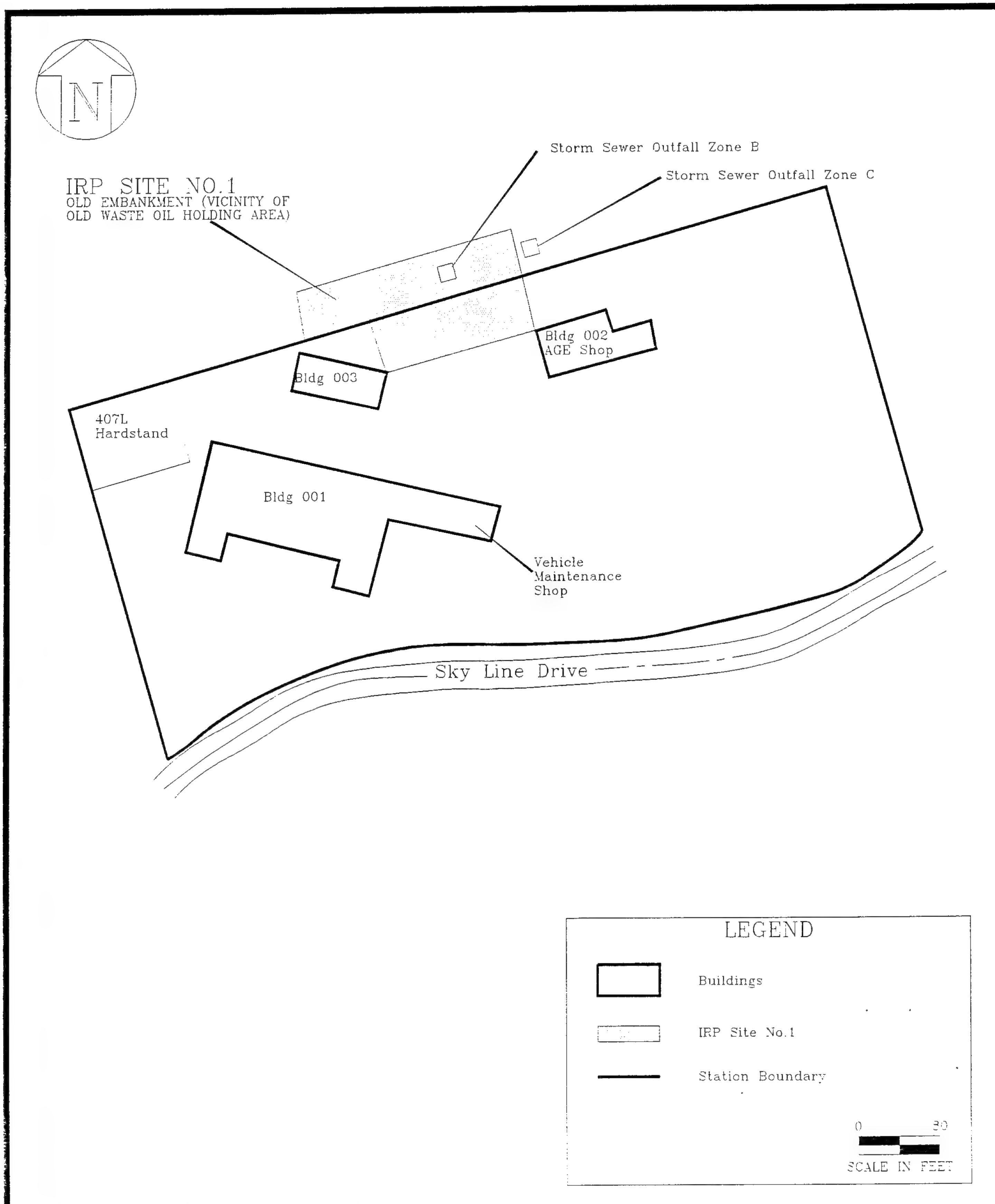
### 2.2.1 Location

The southern boundary of the site extends from the northeast corner of Building 3 (Storage Building) to the northwest corner of Building 2 (AGE Shop). The site extends to the north approximately 30 feet beyond the northwest perimeter fence. The north boundary of the site parallels the fence line. The Old Embankment extended from the northwest corner of Building 2 to the northeast corner of Building 3 until the 1970s and early 1980s, at which time the low area located between the embankment and current fence line was filled in with construction debris. The site extends to the base of the current embankment which parallels the northern fence line. A portion of the site lying outside of the fence line has been extended approximately 40 feet to the southwest to include a portion of the current embankment (Figure 2.2).

### 2.2.2 Site History

The PA conducted in May 1990 determined IRP Site No. 1 was subject to four different waste handling and disposal activities. The approximate time frame and a brief description of these activities, as identified in the PA, are provided below.

From at least as early as 1969 until the early 1980s, waste oil, organic solvents, and fuels were used to kill weeds along the Old Embankment. Reportedly, 20 to 30 gallons of these wastes were poured along the embankment yearly.




SOURCE: Worcester ANG Station, Worcester, Massachusetts, ANG Development Plan, 1989.

FIGURE 2.2

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IRP SITE NO. 1 WORCESTER AIR NATIONAL GUARD STATION

101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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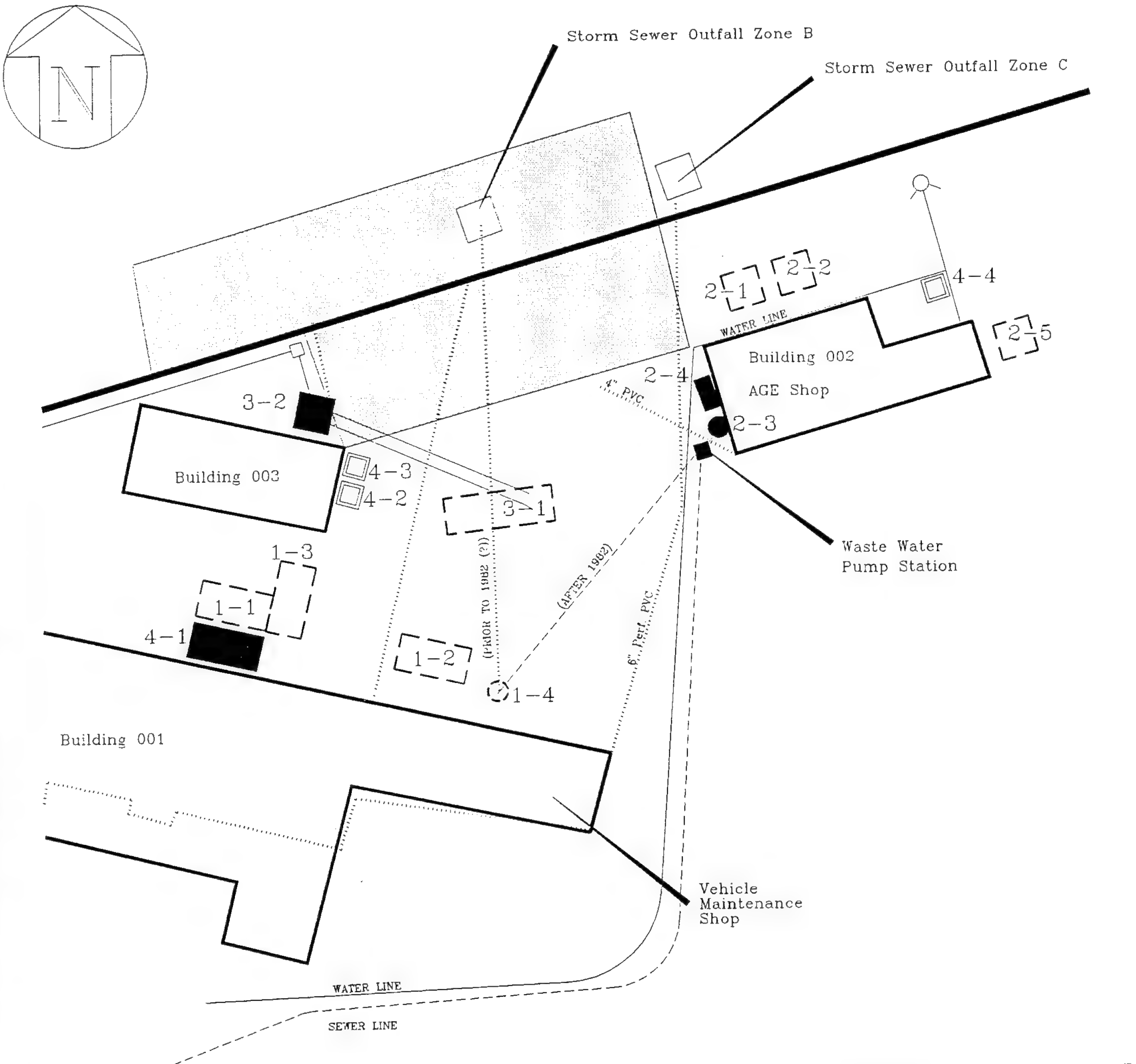
From 1975 until about 1981, waste oil, PD-680, xylene, JP-4, JP-5, and diesel from maintenance activities were temporarily stored in the Old Waste Oil Holding Area adjacent to the northwest perimeter fence in the east portion of the site area. The storage area was paved, but was adjacent to an exposed soil area. Reportedly, lids were sometimes left off drums, allowing the contents to spill or overflow onto the exposed soil.

Mobile generators that run on JP-4 and JP-5 are stored in the Generator Parking Area along the fence in the southwestern portion of the site. Numerous small fuel spills (less than 1 gallon) and about five larger fuel spills, approximately 30 gallons each, have occurred between 1975 and 1988. Additionally, one-gallon cans used to collect fuel drained from the generators were emptied across the fence after being contaminated with precipitation.

Prior to 1982, the OWS (Figure 2.3, Tank #1-4) connected to floor drains in the vehicle maintenance shop that discharged to storm sewer outfall zone B. Waste oil was sometimes poured directly into the floor drains on the assumption that it would be captured by the OWS. During removal of USTs at the Station in November 1993, it was discovered that the OWS was actually a dry well with a gravel bottom. During the dry well removal, the surrounding soil was also removed, and soil staining was noted; however, no soil sampling was conducted at that time. Since 1982, discharge from the Vehicle Maintenance Shop is routed to the OWS at Building 002 (Figure 2.3, Tank #2-3) and discharges to the sanitary sewer system. The PA concluded that these past activities at the site have resulted in the potential for contamination and recommended further study under the IRP.

### 2.2.3 Potential Release Sources

As discussed above, weed control activities used quantities of waste oil, organic solvents, and fuels along the perimeter fence and embankment. Small spills from the Old Waste Oil Holding Area adjacent to the northwest perimeter fence were reported where waste oil, PD-680, xylene, JP-4, JP-5, and diesel were stored. Numerous fuel spills in the mobile generator area along the fence in the southwest portion of the site were also recorded. Additionally, one-gallon cans used to collect fuel drained from the generators were emptied across the fence after being contaminated with precipitation. Waste oil was reportedly poured directly into the floor drains in the vehicle maintenance shop on the assumption that it would be captured by an OWS. However, with the discovery of the dry well, potential contaminants infiltrated through the gravel bottom and discharged to the storm sewer outfall zone B outside the perimeter fence.




| UNDERGROUND TANK IDENTIFICATION # | CAPACITY (GALLONS) | PRODUCT | YEAR INSTALLED |
|---|---|---|---|
| 2-3 | 400 | O/W. SEPARATOR | 1993 |
| 2-4 | 150 | JP-5 | 1981 |
| 3-1 | 12,000 | JP-5 | 1976 |
| 3-2 | 275 | JP-5 | 1976 |
| 4-1 | 8,000 | #2 FUEL OIL | 1993 |
| 4-2 (AST) | 5,000 | GASOLINE | 1993 |
| 4-3 (AST) | 5,000 | DIESEL FUEL | 1993 |
| 4-4 (AST) | 2,000 | #2 FUEL OIL | 1993 |

LEGEND

- Buildings
- Storm Drain
- Site No.1
- Former Location of Removed UST
- Station Boundary
- Underground Tank
- Oil/Water Separator
- Water Line
- Sewer Line
- Above Ground Storage Tank

0 40 80
SCALE IN FEET

SOURCE: PENNY ENGINEERING, INC., SITE PLAN, 1994.

FIGURE 2.3

WORCESTER WORC4-2S

OIL/WATER SEPARATORS AND USTs VICINITY OF IRP SITE NO.1

101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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In 1993, as part of a national ANG program, all but two of the underground storage tanks (USTs) at the Station were removed under the direction of Wadleigh Environmental of Boston, Massachusetts (Figure 2.3). During removal, contamination was found around an existing 10,000-gallon fuel oil UST north of Building 1, and was confirmed by laboratory analysis. The OWS outside Buildings 1 and 2 (Vehicle Maintenance and AGE Building, respectively) was removed; however, no laboratory analysis was performed on the surrounding soils. Additionally, it was determined that the OWS was a dry well and not an OWS system. The existing diesel, MOGAS, waste oil, waste JP-5 and #2 fuel oil USTs were also removed. No laboratory analysis was performed on surrounding soils of these remaining tanks, with the exception of the #2 fuel oil tank associated with Building 2. The contractor punctured the #2 fuel oil tank for Building 2 during removal. An immediate Response Action (IRA), pursuant to Massachusetts Contingency Plan (MCP), was filed by the contractor with MADEP for both #2 fuel oil tanks for Buildings 1 and 2. The site where the #2 fuel oil tank was punctured has been cleaned.

Leakage from the 10,000-gallon fuel tank may have affected soil quality in the area of IRP Site No. 1. However, any future investigations and/or remedial activities conducted as a result of fuel releases from the USTs and/or associated piping will be addressed by the ANGRC compliance section; these areas will not be investigated as IRP sites.

## SECTION 3.0 ENVIRONMENTAL SETTING

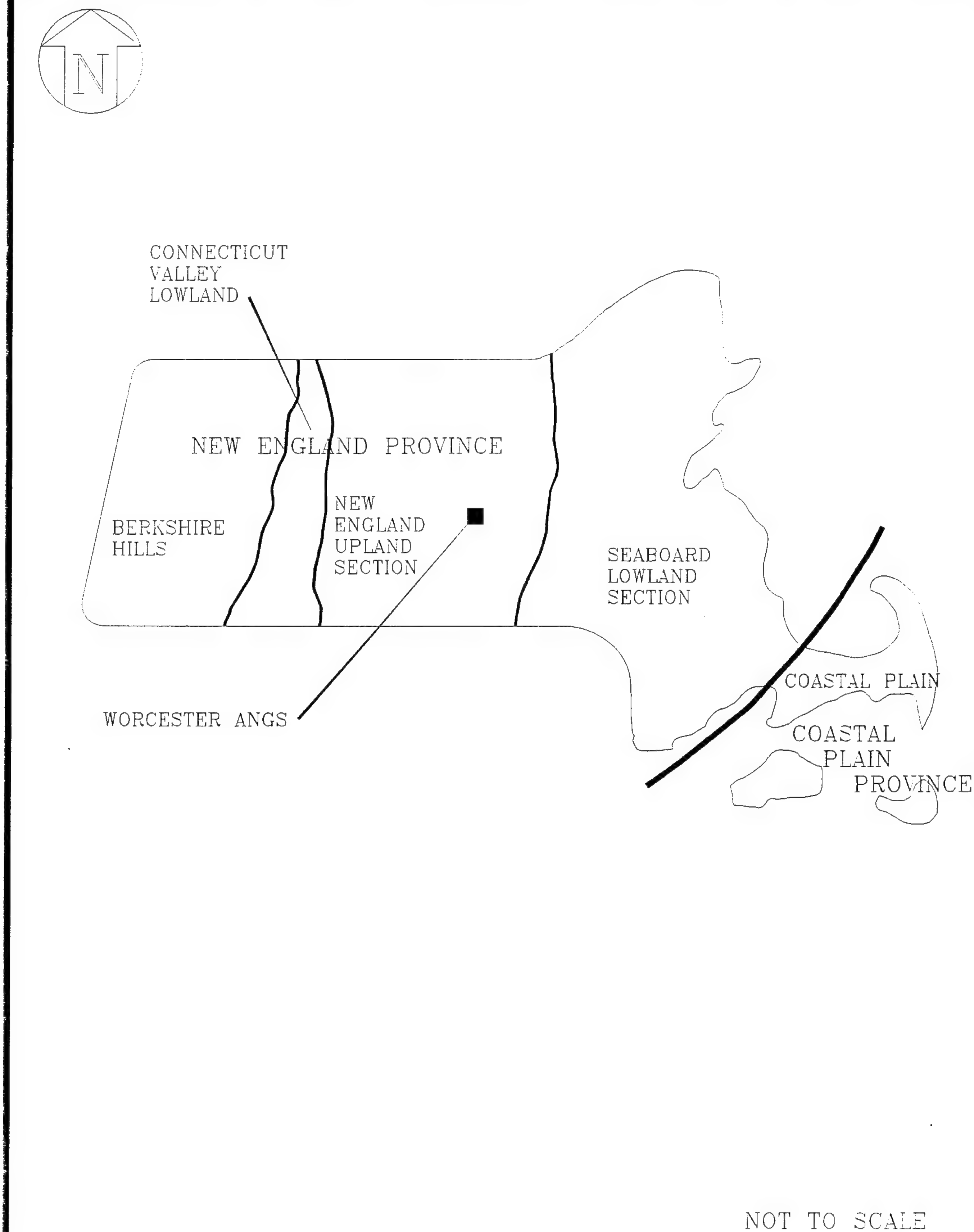
No previous Site Investigations have been conducted at Worcester ANGS. However, environmental information in the PA referenced the Climatic Atlas of the United States (United States Department of Commerce, National Climatic Data Center, Asheville, North Carolina, 1979), Soil Survey of Worcester County, Massachusetts, Northeastern Part (United States Department of Agriculture: Soil Conservation Service, 1985), Surficial Geologic Map of the Worcester North Quadrangle and Part of the Paxton Quadrangle, Worcester County, Massachusetts (Stone, 1980), Water Resources of the Blackstone River Basin, Massachusetts (Walker and Krejmas, 1986), and Bedrock Geologic Map of the Natick Quadrangle, Middlesex and Norfolk Counties, Massachusetts (Nelson, 1975), where applicable, to describe the environmental and geologic setting, soils, and hydrogeology at Worcester ANGS.

### 3.1 PHYSIOGRAPHY

Massachusetts is divided into the New England and Coastal Plain physiographic provinces. The southeastern peninsula and outer islands of Massachusetts are included in the Coastal Plain province while the remainder of the State exists in the New England province (Figure 3.1). The New England province is further subdivided into sections. The Station is located in the east-central section, termed the New England Upland. This region is characterized by moderately high relief determined by the distribution and resistance of bedrock in relation to pre-glacial and glacial erosion.

### 3.2 CLIMATE

The climate in the area of Worcester ANGS is characterized by cold winters and moderate summers with occasional hot spells. Precipitation is evenly distributed throughout the year. The total average annual precipitation, based on a 27-year record (1951-1978), is 45.59 inches, and ranges from an average monthly high of 4.49 inches in November to an average monthly low of 3.36 inches in July. By calculating net precipitation according to the method outlined in the Federal Regulations CERCLA Pollution Contingency Plan (United States Environmental Protection Agency, 55 FR 8813, Subpart K, March 8, 1990), a net precipitation value of 18.59 inches is obtained. The heaviest rainfall during the reporting period was 4.43 inches at Fitchburg on September 12, 1954. The 1-year, 24-hour average rainfall is approximately 2.5 inches. Thunderstorms occur on an average of 21 days a year, and an average of 22 days a year have at least one inch of snow on the ground. The average annual temperature for the 27-year reporting period was 48.0° F (Fahrenheit), and the average monthly temperature ranged from




Source: Frimpter, M.H. Massachusetts Ground-Water Resources, USGS, Water Supply Paper #2275, 1984.

| | | |
|---|---|---|
| FIGURE 3.1<br>WORCESTE WORC4-GP | PHYSIOGRAPHIC MAP OF MASSACHUSETTS<br>101st ACS and 212th EIS<br>Worcester Air National Guard Station<br>Worcester, Massachusetts | OPTECH<br>OPERATIONAL TECHNOLOGIES CORPORATION<br>JANUARY 1995 |

71.9° F in July to 24.0° F in January. Prevailing wind direction is from the west. Average windspeed is highest in the winter at approximately 14 miles per hour.

## 3.3 GEOLOGY

The geology and landforms of the central Massachusetts area are characterized by glacial topography with moderate to moderately high relief determined by resistant bedrock and glacial erosion. Topographic elevations increase from the easterly river valley lowlands toward the maturely dissected plateau to the west (Stone, 1980). Surface elevations range from 350 to 780 feet (107 to 238 meters) above mean sea level (MSL) in the immediate vicinity of Worcester ANGS. The Station is located along a subdued escarpment which is oriented in a north to south direction. Specifically, the Station is located on the top of a bedrock-resistant hill named Millstone Hill, where the surface elevation is approximately 750 to 780 feet (229 to 238 meters) above MSL.

The bedrock underlying the Station is mapped by Emerson, 1917, as being the Lower Cambrian age Ayer Granite. The Ayer Granite was quarried on Millstone Hill immediately west of the Station. Where it was quarried, Emerson described the rock as lightly colored, coarse-grained, muscovite-biotite granite, containing some blue quartz. According to Mr. Bob Oldale of the United States Geological Survey (USGS) regional office in Marlborough, Massachusetts, no studies have been conducted on the chemical composition of the Ayer Granite.

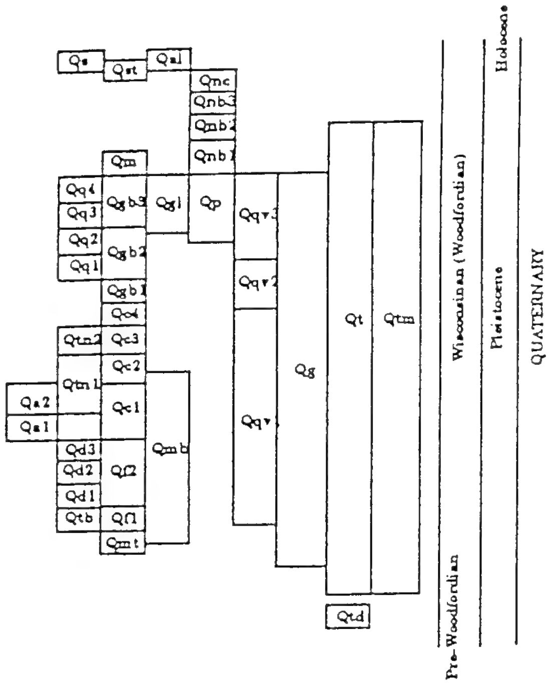
The Ayer Granite has since been named the Ayer Intrusion Complex which consists of several members. Mapping by Barosh in 1977 indicates the Station is underlain by the Millstone Hill Granite Member. It is described as a light gray, medium-grained, equigranular, nonfoliated granite to granodiorite that weathers light buff to rusty on outcrop. The structural grain of the bedrock in the area is oriented to the northeast, and the dominant structural features are thrust faults and perpendicular normal faults. Several thrust faults are mapped as occurring in the immediate vicinity of the Station. The large amount of faulting probably has fractured the bedrock to a significant degree at the Station location. In his examination of the Ayer Granite on Millstone Hill, Emerson, 1917, reported observing master vertical joints and minor irregular sets of joints that suggested significant fracturing of the bedrock. Fracturing is important in that it creates secondary porosity and permeability in the bedrock which is otherwise nonpermeable.

The bedrock in the vicinity of the Station is, for the most part, covered by a thin layer of surficial material of varying thickness (Walker and Krejmas, 1986). Surface material is primarily composed of Pleistocene glacial deposits and, to a lesser degree, postglacial Holocene

deposits. Postglacial material generally consists of stream-terrace, alluvium, and swamp deposits. The postglacial deposits generally occur in topographic lowlands and are very limited in areal extent due to the upland nature of the area. As a result of the high topographic position of the Station, surface material is composed only of Pleistocene glacial deposits and the corresponding overlying soils.

Glacial ice moved across the area in a general southerly direction. Pre-glacial surface deposits and weathered bedrock were removed by the effects of glacial erosion (Stone, 1980). In the wake of glaciation, a thin veneer of glacial drift was deposited in varying thicknesses, covering much of the bedrock. Glacial deposits consist primarily of nonstratified till, stratified glacial-lake deposits and stratified glacial-stream deposits. Nonstratified till is widespread throughout the area and is exposed in the upland. Stratified glacial deposits are generally younger and exist in lower topographic levels than the nonstratified deposits. This results from the stratified material being deposited by glacial meltwater derived from deglaciation (Nelson, 1975).

The Station is underlain by nonstratified glacial till. Three basic types of till have been identified in the area (Stone, 1980). They are termed the Drumlin, Woodfordian, and the Mixed (which is composed of the two previous types). A detailed lithologic description of each is given in Figure 3.2. Specifically, the Station is underlain by the noncompact variety of the Woodfordian till (Figure 3.3), which is composed of a poorly sorted mixture of pebbles, cobbles, and boulders in a fine sand matrix. As a result of the poor sorting, the till has very low permeability. Deposited over the resistant bedrock at the Station location, the Woodfordian till exists as a thin ground moraine. The thickness of the till is generally less than 10 feet (or 3 meters), and total thickness of the surficial material at the Station is projected at substantially less than 10 feet (or 3 meters). Bedrock outcrops exist at or very near the surface in the immediate vicinity of the Station (Figure 3.3). The Drumlin till is not present at the surface in the general vicinity of the Station. However, the mixed till is mapped as occurring north, west, and southwest from the Station on the adjoining hills (Figure 3.3). Deposits of stratified glacial material do not exist in the immediate proximity of the Station. Deposits of stratified glacial material exist in the topographic lowlands located west, south, and east from the Station. The distance of these deposits in relation to the Station is approximately 0.85, 0.66, and 0.99 miles, respectively.




Qgb3 Qgb2 Qgb1 GATES BROOK DEPOSITS-Fluvial lacustrine section as much as 16 m thick under flat delta plain (unit Qgb2), graded to spillway north of Woodland Street

Qtn2 Qtn1 TANNERY BROOK DEPOSITS-Fluvial lacustrine section 10-15 m thick, graded to spillway at Mass Route 31.

Qc4 Qc3 Qc2 Qc1 CHAFFIN POND DEPOSITS-Fluvial-deltaic section 20-25 m thick, locally overlies lake bottom silt and fine sand as much as 12 m thick (HRW-140, UNIT Qc2), graded to spillway at southeast corner of Chaffin Pond

Qa2 Qa1 ASNEBUMSKIT BROOK DEPOSITS-Fluvial-lacustrine section (Qa1) as much as 18 m thick, graded to spillway at south end of Kendall Reservoir; fluvial-lacustrine section (Qa2) as much as 20 m thick, graded to spillway east of Eagle Lake.

Qd3 Qd2 Qd1 DAWSON POND DEPOSITS- Fluvial-lacustrine section 12 m thick; graded to local spillways.

Qtb TATNUCK BROOK DEPOSITS-Collapsed coarse fluvial sediments 4 m thick, and local sand and silt pond-bottom sediments, graded to local spillways.

Qf2 Qf1 FARM BROOK DEPOSITS-Collapsed fluvial-lacustrine section (Qf1), locally 20 m thick, graded to local spillways, fluvial-lacustrine section (Qf2), 30 m thick, graded to spillway on northeast side of Winter Hill.

Qt TILL (PLEISTOCENE-WISCONSINAN [WOODFORDIAN])-Two types of till are included in the map unit. The most areally abundant type of till is a noncompact, gray (nonoxidized), poorly sorted mixture of pebbles, cobbles, and boulders in a fine-sand matrix. Irregular lenses of waterlaid sand and gravel are common. The noncompact till is irregularly distributed in the uplands, locally on top of bedrock and the compact till described below, and generally less than 3 m thick. The second type of till is a compact, gray (nonoxidized), poorly sorted mixture of pebbles, cobbles, and few boulders having fine sand matrix in the uplands and a silty matrix in Beaver Brook and Nashua River lowlands. The till may be locally as much as 6 m thick. The compact till underlies many of the meltwater deposits in the lowlands (logs HRW-58, HRW-61, HRW-140, WSW-25, XSB-007, XSB-118).

Qtm MIXED TILL (PLEISTOCENE-WISCONSINAN [WOODFORDIAN])-Chiefly compact sandy gray Woodfordian till at the surface, 1-2 m thick, containing discrete pebble size angular clasts of olive-brown, oxidized drumlin till (pre-Woodfordian unit Qtd), passing downward into a 1-3 m zone of mixed loose sandy gray till matrix and elongate boulder-size olive-brown and gray (nonoxidized) drumlin till clasts, locally bounded by irregular, thin sand and silt laminae and lenses, locally overlying very large gray and olive drumlin till clasts having few parting laminae and no loose sandy matrix; all or part of mixed till unit overlies thick drumlin till in drumlin cores. Extent of unit shown schematically, inferred from exposures of mixed till and drumlin till, subsurface drilling data and drumlin morphology.

Qtd DRUMLIN TILL (PLEISTOCENE-PRE-WOODFORDIAN)-A very compact mixture of few pebbles and cobbles in a fine silt and clay matrix. At the top, the till is olive brown and has a pervasive iron oxide stain throughout the matrix, a subhorizontal fissility is locally developed. This fissility and a weakly developed subvertical joint system impart an angular blocky structure to the till. Black iron and manganese oxide coatings, and thin clay coatings are common along vertical parting surfaces and occur on some horizontal parting surfaces. The oxidized till grades downward 3-6 in. to nonoxidized, nonfissile, dense dark-gray till. Total thickness of gray, olive-brown, and mixed pre-Woodfordian and Woodfordian till may exceed 20 m in drumlins. Angular clasts of silt, fine sand, and clay in thin and irregular laminae interbedded with thin beds of drumlin till were exposed in a temporary highway cut in drumlin till north of Indian Hill. The clasts are included in an angular breccia, more than 3 m thick, which also includes larger compact clasts of drumlin till in a sheared matrix.

DESCRIPTION OF MAP UNITS

Mapped deposits are generally 1 m or more thick. A mantle of yellowish-orange windblown silt and fine sand, commonly mixed with sand and stones of the underlying glacial deposit, irregularly covers many of the mapped deposits; it is not shown where less than 1 m thick.

POSTGLACIAL DEPOSITS

Qal ALLUVIUM (HOLOCENE) - Dark gray to buff sand, silt and pebble-cobble gravel, containing variable amounts of organic material. Texture is highly variable. Alluvium underlying wide parts of the Quinapoxet River flood plain generally fines upward from gravel at the base to fine sand exposed in the flood plain: coarse gravel and sand alluvium underlying narrow flood plain areas is as thick as 3 m and overlies glacial-lake deposits (log HRW-56). Alluvium in tributary valleys is generally sand and locally fine to medium gravel, less than 2 m thick.

Qs SWAMP DEPOSITS (HOLOCENE AND PLEISTOCENE)-Includes muck and peat and minor amounts of sand, silt, and clay. Swamp deposits in valley kettle holes and adjacent to man-made ponds are generally less than 10 m thick. Upland swamp deposits are less than 6 m thick.

Qst STREAM-TERRACE DEPOSITS (HOLOCENE AND PLEISTOCENE - Buff to brown pebble gravel and sand, pebbly coarse sand, or sand and silt. Deposits along Quinapoxet River, as thick as 6 m, overlie glacial-lake deposits (log HRW-61).

GLACIOFLUVIAL DEPOSITS (PLEISTOCENE-WISCONSINAN (WOODFORDIAN)-Sand, gravel, and minor silt, coarse, and fine-textured beds are interlayered in vertical section; sediments were deposited by meltwater streams in successive south to north ice retreatal positions in narrow valleys and are graded to local base levels; upstream parts of each deposit were laid down in contact with stagnant ice, deposits range from cobble boulder gravel in massive, poorly sorted, horizontally layered beds in the ice-contact part of each unit, to crossbedded and horizontally bedded gravel, pebbly sand, and sand having minor fine sand and silt interbeds in downstream part of unit, deposits average 10 m in thickness and are locally as thick as 20 m, contain local kettle-hole sediments of silt, clay, and organic material (logs XSB-n15, XSX-10).

SOURCE: USGS, Surficial Geologic Map of the Worcester North Quadrangle and Part of the Paxton Quadrangle, 1980.

FIGURE 3.2

WORCESTE\WORC4-4G

GENERALIZED STRATIGRAPHIC COLUMN OF THE AREA
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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Qp POOR FARM BROOK DEPOSITS-Generally less than 8 m thick, glacial to narrow channel at south end of deposit

Qg GLACIAL MELTWATER DEPOSITS, UNCORRELATED-Includes minor deposits, fluvial and fluvial deltas, not clearly related to major meltwater deposits, graded to local base levels.

Qmb Qmt MIDDLE RIVER DEPOSITS-Locally 18 m thick (logs XSX-10, XSX-26) at Rural Cemetery, more than 20 m thick beneath downtown Worcester (logs XSB-n15, XSB-n106) graded to base level at head of Blackstone River in the Worcester South quadrangle.

Qw WADSWORTH BROOK DEPOSITS-Graded to narrow channel under Holden Reservoir No. 2; 10-15 m thick.

Qk KETTLE BROOK DEPOSITS-Average 10 m in thickness

GLACIAL FLUVIAL-LACUSTRINE ICE-CONTACT DEPOSITS (PLEISTOCENE-WISCONSINAN [WOODFORDIAN])-Fluvial, deltaic and lake-bottom deposits in major ice-marginal lakes in the Nashua River and Quinsigamond lowlands. Fluvial beds grade from cobble gravel, as much as 15 m thick (Qnb1), deposited on top of till or bedrock along valley walls to pebble cobble gravel and interbedded sand 1-3 m thick, overlying inclined delta foreset beds. Foreset strata are interbedded pebbly sand, sand, and pebble cobble gravel, 10-15 m thick in upstream parts of deltas, downstream foreset beds are sand and silt. Collapsed fluvial and deltaic beds are as much as 30 m thick in Quinsigamond valley (logs XSB-007, XSB-141). Lake-bottom silt and sand and minor clay, 20 m thick, underlies Qnb1,2 deposits and locally underlies Quinsigamond valley deltaic deposits (logs XSB-118, XSB-133).

GLACIAL LAKE NASHUA DEPOSITS-Deltaic, fluvial, and lake-bottom sediments deposited in or graded to the Boylston (Qnb1-3) Stage or Clinton (Qnc) Stage of glacial Lake Nashua, the bedrock-floored saddle just below 450 ft. (137 m) elevation at the south end or Wachusett Reservoir was the spillway for the Boylston Stage. A bedrock spillway at 350 ft. (107 m) elevation at Rattlesnake Hill, Clinton quadrangle controlled the level of the Clinton Stage (Koteff, 1966).

Qnc Clinton Stage Deposits-Chiefly fluvial sediments less than 8 m thick. Deposits overlie older Boylston Stage lake bottom and collapsed deltaic sediments

Qnb3 Qnb2 Qnb1 Boylston Stage Deposits-Fluvial-lacustrine section 30-40 m thick fluvial sediments (Qnb1) as much as 15 m thick beneath West Boylston village, locally collapsed fluvial and deltaic beds as much as 30 m thick (log WSW-25).

Qqv3 Qqv2 Qqv1 Quinsigamond Valley Deposits-Coarse-grained fluvial lacustrine section generally 20-30 m thick (logs XSB-141, XSB-007), locally as much as 30 m thick (logs XSB-118, XSB-133) graded to interconnected ice-marginal ponds controlled by spillway to Grafton quadrangle.

GLACIAL LACUSTRINE ICE-CONTACT DEPSOTIS (PLEISTOCENE-WISCONSINAN [WOODFORDIAN])-Sand, gravel, and minor silt in overall coarsening upward vertical sections, fluvial and deltaic sediments graded to or deposited in contact with stagnant ice, horizontally layered pebble-cobble to cobble gravel and interbedded sand in fluvial topset beds, commonly 4 m thick, overlying inclined delta foreset beds composed of sand, pebbly sand, and pebble gravel, and silt, 5-15 m thick. Coarse-grained topset and foreset beds are intermixed in collapse faults and folds along ice-contact margins of each deposit. Delta bottom set beds and lake-bottom beds, thinly laminated silt and very fine sand, locally more than 10 m thick, underlie deltaic deposits (units Qc2,3, log HRW-140; Ql1,2, log HRW-69; Qd2 and Qm1,2). Correlation of deposits between depositional basins is tentative.

Qm MALDEN BROOK DEPOSITS-Fluvial-lacustrine, as much as 22 m thick, graded to local spillways cut in till

Ql LOWER GATES BROOK DEPOSITS-Fluvial-lacustrine section 10-14 m thick, graded to spillway at Summit

Qc4 Qc3 Qc2 Qc1 QUINAPOXET RIVER DEPOSITS-Fluvial-lacustrine section as much as 33 m thick, graded to spillway southwest of Malden Hill

af ARTIFICIAL FILL-Compacted fill excavated from meltwater deposits sandy and compact fill. fill under highways, railroads, buildings, and earthdams is commonly compacted to optimum moisture content. Ruled pattern indicates areas of extensive artificial fill, 3-6 m thick, overlying mapped surficial deposit or areas of major excavations and man-made changes of topography.

SHALLOW BEDROCK AND BEDROCK OUTCROPS-Ruled pattern indicates areas where surficial deposits are generally less than 3 m thick locally containing numerous bedrock outcrops, inferred from outcrop pattern, aerial photography interpretation, and subsurface data, solid areas represent continuous outcrop (data in uplands from Hepburn, 1976a).

SOURCE: USGS, Surficial Geologic Map of the Worcester North Quadrangle and Part of the Paxton Quadrangle, 1980.

FIGURE 3.2 (CONCLUDED)

WORCESTER NORTH-47

GENERALIZED STRATIGRAPHIC COLUMN OF THE AREA
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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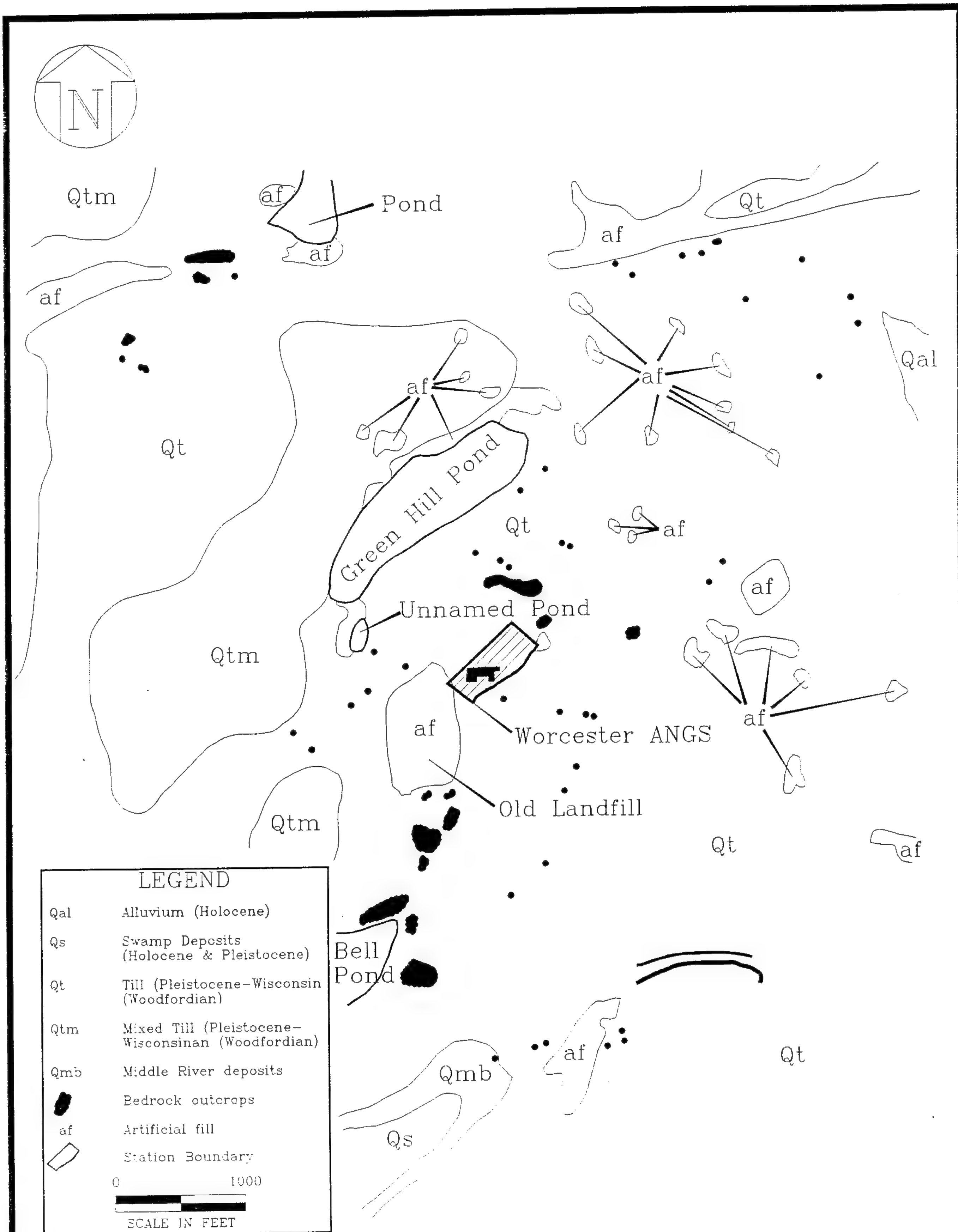


SOURCE: USGS, SURFICIAL GEOLOGIC MAP OF THE WORCESTER NORTH QUADRANGLE AND PART OF THE PAXTON QUADRANGLE, 1980

FIGURE 3.3

SURFICIAL GEOLOGIC MAP OF THE AREA
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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JANUARY 1995

## 3.4 SOILS

The soil overlying the glacial till at the Station location is classified as the Chatfield-Hollis-Rock outcrop complex. This soil type is formed in association with glacial till and is characteristic of hills and ridges with many bedrock exposures. The soil unit is irregular in shape and averages approximately 20 acres in areal extent. The complex is composed of moderately deep Chatfield soils (45%), shallow Hollis soils (25%), Rock outcrop (15%), and other soils (15%). The soils are intermingled and cannot be mapped separately. Chatfield soils consist of a fine sandy loam, and the depth to bedrock ranges from 20 to 40 inches. Hollis soils are also composed of a fine sandy loam, but the lower 5 inches of subsoil are a gravelly fine sandy loam. Depth to bedrock ranges from 10 to 20 inches for the Hollis soils. The Chatfield and Hollis soils are considered to be well-drained to somewhat excessively drained soils. Permeability is classified as moderate (0.63 to 2.00 inches per hour, or $4.45 \times 10^{-4}$ to $1.41 \times 10^{-3}$ centimeters per second (cm/sec)) or moderately rapid (2.00 to 6.00 inches per hour, or $1.41 \times 10^{-3}$ to $4.24 \times 10^{-3}$ cm/sec).

## 3.5 HYDROGEOLOGY

The principal aquifers of the Blackstone River Basin, which include Worcester County, are the sand and gravel deposits of glacial origin and the underlying bedrock (Walker and Krejmas, 1986). The glacial sand and gravel aquifer is of primary importance because of its capacity to yield large volumes of water necessary for public use. Bedrock is of secondary consideration because it characteristically yields small volumes of water generally not suitable for public demand. However, in some rural areas, fractured bedrock is the only groundwater source, and, in some cases, is used as a public supply. The bedrock is the only water-bearing strata present at the Station location.

The glacial sand and gravel aquifer primarily occurs as stratified glacial drift deposited by water derived from melting glaciers (Walker et al., 1975).. The occurrence of the stratified glacial deposits are generally limited to topographic lowlands and valleys (Walker and Krejmas, 1986). The yield capability of the sand and gravel aquifer is determined by its thickness, particle size, and degree of particle sorting or stratification. Well-sorted, coarse-grained deposits of a thicker nature generally produce the highest yield of water. The stratified glacial aquifer does not exist at the Station location or in the immediate vicinity. The nearest outcrop identified in the PA is approximately 0.66 miles to the south of the Station.

Undisturbed bedrock in the area is composed of basically nonporous and impermeable granite. Consequently, it is dependent on secondary fracturing to function as an aquifer (Walker and Krejmas, 1986). As a result of the extensive structural deformation of the area, fracturing of the bedrock is widespread; therefore, the bedrock will yield a limited amount of water at almost any location. The amount of yield is directly dependent on the size and amount of water-bearing fractures that exist at a given location. Predicting the amount of fracturing occurring in an area is very difficult. Wells might penetrate enough water-bearing fractures 50 feet below the water table for a satisfactory yield at one location, while at another location, a well might penetrate several hundred feet without intersecting any water-bearing fractures (Walker and Krejmas, 1986). Generally, bedrock wells located in topographic lowlands will have higher yields than wells situated in upland areas. This is likely attributed to added recharge from upland areas and the overlying groundwater stored in the stratified glacial aquifer in the lowland areas (Walker and Krejmas, 1986). The yield capacity of the bedrock aquifer varies greatly because of the irregular distribution and size of the water-bearing fractures. Walker and Krejmas, 1986, report a yield range of 0.2 to 125 gallons per minute (gpm), with an average yield of 10 gpm for bedrock wells.

Groundwater within the bedrock aquifer is unconfined within the limits of the fracture system, but occasionally artesian conditions do exist. General groundwater movement can be determined locally by the topography. Groundwater movement is interpreted as occurring perpendicular to surface elevation contours. Due to the high topographic position of the Station, general groundwater movement likely occurs downgradient to the northwest and southwest from the Station. The depth to the water table at this location is estimated at 30 to 50 feet below land surface (BLS).

The susceptibility of groundwater to contamination from the Station is considered to be a moderate risk. This is inferred because the stratified glacial aquifer does not exist either at the Station location or in surface water runoff pathways from the Station. The soil and glacial till underlying the Station is thin and laterally discontinuous. The bedrock is a consolidated, impermeable material that primarily serves as a low yield aquifer only where sufficient fracturing occurs. Based on the extensive structural deformation that has occurred in the area and the fracturing in the bedrock at the adjacent quarry, observed by Emerson, 1917, it is likely that significant fracturing does exist. However, the bedrock is not developed extensively as a domestic water source in the immediate vicinity of the Station.

The potable water supply for the Station is provided from surface water sources by the City of Worcester Department of Public Works, Water Operations; several reservoirs outside the City

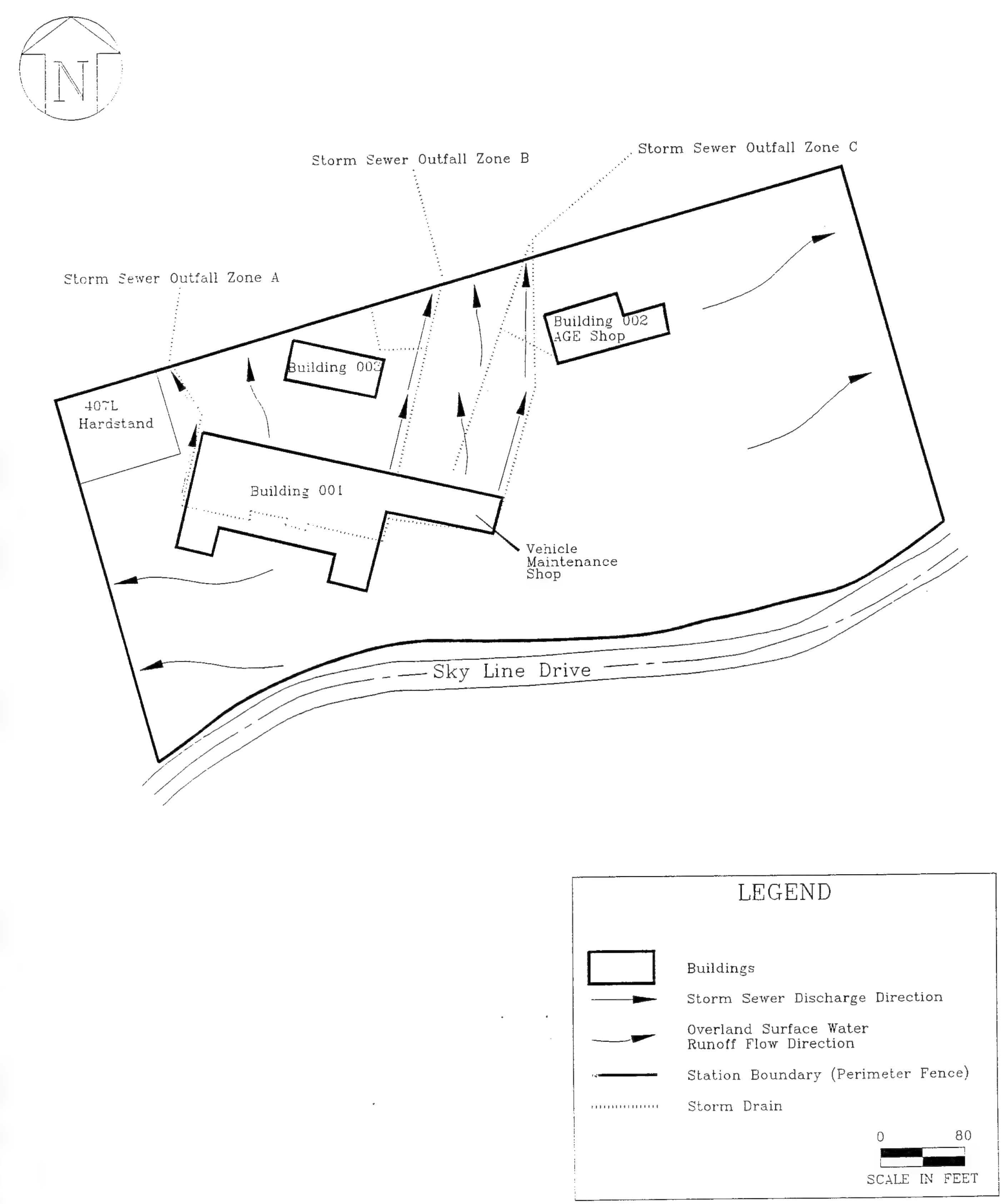
limits of Worcester are utilized for this surface water supply. According to Mr. Bob Peterson of the Department of Public Health and Code Enforcement for the City of Worcester, currently 100 percent of the City's potable water supply is provided by surface water, and no groundwater sources are used. There are no water wells located on the Station, and there are no domestic water supply wells within a 1-mile radius of the Station, according to a list of water wells supplied by the Department of Public Health and Code Enforcement (included in Appendix F). Mr. Peterson stated that currently no requirement exists for registration of water wells and, in his opinion, a number of the wells included on the list are not currently in use.

Information contained in the 1991 PA conducted by Science & Technology for the Worcester ANGS stated that the nearest active well in relation to the Station was located approximately 0.5 miles south at the base of Millstone Hill. However, according to the Health Department water well listing, no domestic or commercial water well is shown in that general area, and the well location could not be identified.

## 3.6 SURFACE WATER

Surface water on the Station property drains overland, and the drainage can be divided into two basic units. Roughly, the northeast one-third of the Station property drains northeast while the southwest two-thirds drains north and northwest (Figure 3.4). Surface water in the northeast one-third flows overland to the northeast and exits the Station property along the northeastern boundary. From this point, surface water flows north along natural drainage pathways down the slope of Millstone Hill. Before reaching the Green Hill Parkway, the flow direction changes to the west. At this point, the surface water empties into a small, unnamed waterfowl pond at the Green Hill Farm and Education Area. The remainder of the surface flow is in a westerly direction along the Parkway before reaching another small pond located near the intersection of Parkway and Rodney Streets (Figure 3.5). Both ponds serve as passive recreational areas only (e.g., birdwatching, walking, etc.) and are not used for boating, swimming, or fishing. The distance along this drainage pathway from the northwest property boundary to the pond located at the junction of Parkway and Rodney Streets is approximately 2,000 feet (Moore Survey and Mapping Corp., 1975).

In the southwestern two-thirds of the Station, surface water drains overland to the west and northwest (Figure 3.4). Surface water exits the Station property along the northwestern boundary where it flows in a general north/northwesterly direction down Millstone Hill along natural drainage pathways. Before reaching the Green Hill Parkway, the flow direction becomes westerly where it joins the surface water flow from the northeast en route to the pond located




SOURCE: WORCESTER ANG STATION, WORCESTER, MASSACHUSETTS, ANG DEVELOPMENT PLAN, 1989.

| | | |
|---|---|---|
| FIGURE 3.4<br>WORCESTE WORC4-6S | STATION SURFACE WATER DRAINAGE MAP<br>101st ACS and 212th EIS<br>Worcester Air National Guard Station<br>Worcester, Massachusetts | OPTECH<br>OPERATIONAL TECHNOLOGIES CORPORATION<br>JANUARY 1995 |

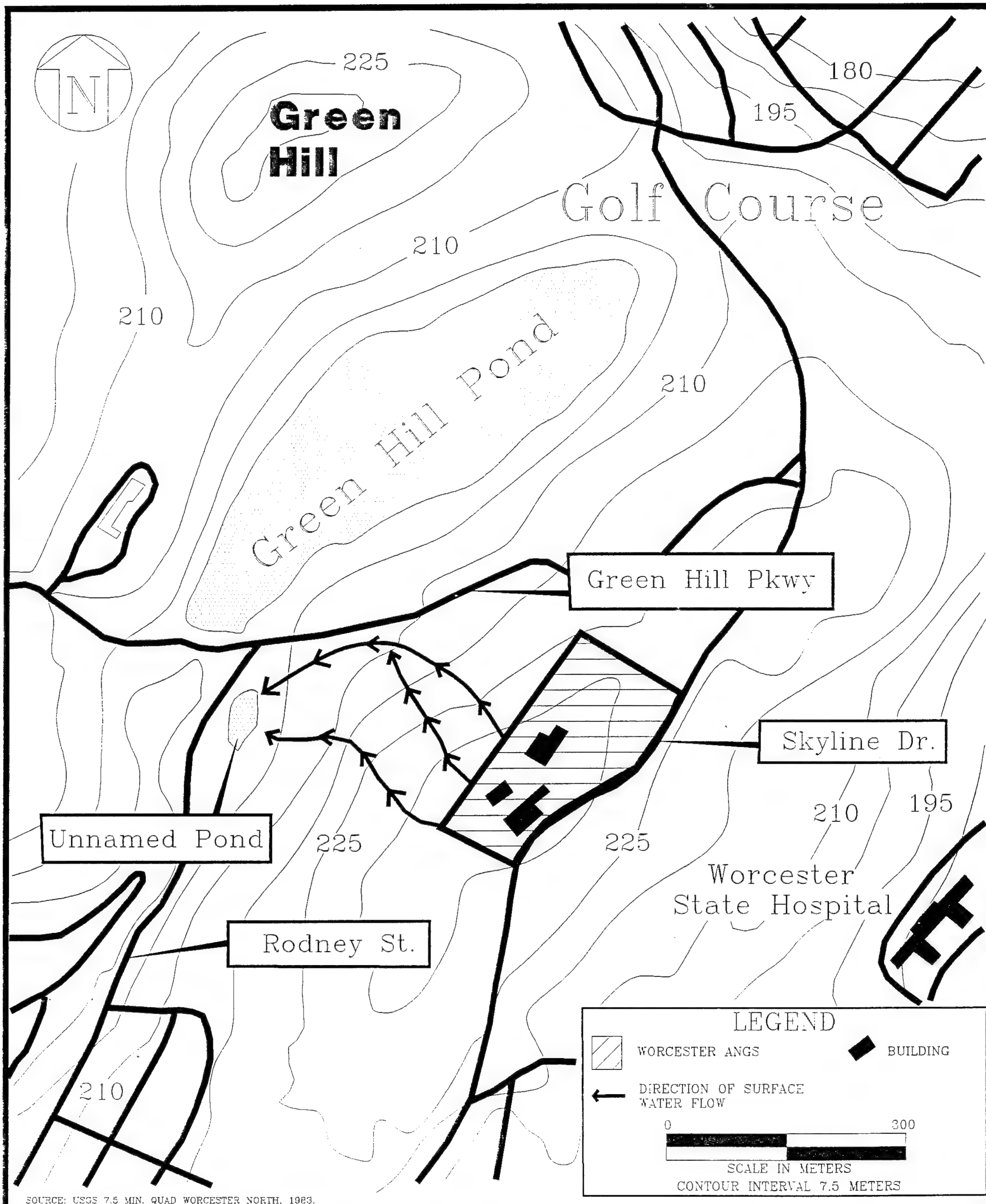



FIGURE 3.5

WORCESTER WORC4-7S

AREA SURFACE WATER
DRAINAGE MAP
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

OPTECH
OPERATIONAL TECHNOLOGIES CORPORATION

JANUARY 1995

near the intersection of Rodney Street and the Parkway (Figure 3.5). The distance of overland flow from the northwest boundary of the Station to the pond along this route is approximately 1,250 feet (Moore Survey and Mapping Corp., 1975). All surface water from the Station outflows overland except water that is collected from the roof of the main building. Water from the building roof is transported underground where it exits along the northwestern boundary (Figure 3.4) and then follows the flow route described for the southwestern two-thirds of the Station.

Once a major portion of the surface water reaches the pond located near the intersection of Rodney Street and the Green Hill Parkway, its destination is unknown. The pond is drained by the City of Worcester storm drainage system, but the records for that section of the system are incomplete. Furthermore, a visual inspection of the system during the PA was inconclusive. As a result of the natural occurrence of the drainage pathways, it is likely that much of the surface water percolates into the soil and surface material before reaching the pond. Surface water flow to the pond occurs only during periods of heavier rainfall.

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# SECTION 4.0 FIELD PROGRAM

The purpose of this SI is to confirm, through field activities, the presence or absence of contamination at the Old Embankment/Vicinity of the Old Waste Holding Area, and, if contamination is identified, to attempt to determine the nature and concentration of the contamination in order to provide data needed to reach a decision for the site. This section describes the field activities performed during the Site Investigation to accomplish the above objectives, and the methodologies used to conduct these activities. The field investigation at the Worcester ANGS commenced on November 15, 1993 and was completed on November 19, 1993.

## 4.1 SUMMARY

The field investigation at the Worcester ANGS incorporated the use of soil borings. Soil borings were installed to determine whether contamination exists at the site, and, if it does exist, to attempt to determine the nature and concentration of the contamination. In addition, soil samples collected from specifically located soil borings established background conditions applicable to the Station.

## 4.2 BACKGROUND

An evaluation of the significance of environmental contaminant concentrations is typically based on a comparison of the levels observed to known background conditions and regulatory-based standards, where applicable. Sampling of soil at background locations was conducted to determine naturally occurring concentration levels, and contaminant or chemical concentrations already existing in the area due to general environmental conditions. Establishing soil background conditions is necessary for risk assessment, establishing cleanup criteria, and making decisions on further site actions. Background locations were located away from any known Station sources of contamination and should provide information on background conditions.

Background data at the Worcester ANGS consisted of two soil borings which were used to obtain soil samples for analytical analysis. Soil samples from the soil borings were collected below the asphalt surface immediately above the bedrock surface to characterize subsurface soil and geological conditions. Actual sample depths submitted for laboratory analysis are discussed in Section 5.1, Background Findings, and shown on the borehole logs included in Appendix A.

## 4.3 DEVIATIONS FROM THE WORK PLAN

There were deviations from the Work Plan noted. However, in no way did any of the changed procedures or protocols prevent accomplishing the overall objectives of this Site Investigation which were to confirm the presence or absence of contamination; to attempt to determine the areal extent of any contaminants detected; and to provide data needed to reach a decision for the site.

The deviations from the Work Plan and the rationale for the changes are described as follows:

- American Society of Testing and Materials (ASTM) Type I reagent water was not used to rinse equipment during the decontamination procedure, as outlined in Section 6.2 of the Work Plan. Distilled water was used in its place. To insure the use of distilled water would not affect analytical results, three field blanks of distilled water were submitted during field work and analyzed for all target analytes. The analytical results of these field blanks confirmed target analytes were not present in the distilled water used to decontaminate equipment or for rinseate blank collection.

- The drilling and sampling program, as outlined in Subsection 6.3.1 of the Work Plan, was modified as required by the specific conditions at the site. Soil samples could not be collected at 5-foot intervals at most locations due to the shallow nature of the bedrock. At several locations, the soil horizon was too shallow to provide two separate sampling intervals. In all cases, however, the objective of collecting a sample below the land surface and immediately above the bedrock surface was accomplished.

- Soil samples collected with the hand auger were not submitted in glass jars as outlined in Subsection 6.3.4.1 of the Work Plan. The samples were collected and contained in brass sleeves. This significantly reduced the volatilization of contaminants during the transfer to the glass jar and allowed for a more accurate characterization of the soil.

- Three additional soil samples were collected along the old perimeter fence, at the request of the ANGRC/CEVR Project Manager, to better characterize the shallow soil conditions at the fence area.

- Methyl-t-butyl-ether (MTBE) was not calibrated in the field GC, as outlined in Subsection 6.3.4.2 of the Work Plan. Since MTBE was not identified as a potential contaminant at the site, the addition of this compound to the calibration standard was not conducted.

- Soil cuttings from the background boreholes were not drummed separately as outlined in Section 7.1 of the Work Plan. Since the depth of these boreholes was less than 3 feet BLS, the soil cuttings from these two boreholes were drummed together to decrease the number of drums to be stored on the facility. All drums were prominently labelled to indicate the boreholes from which the cuttings were collected.

- Laboratory analysis for priority pollutant metals was not conducted using United States Environmental Protection Agency (USEPA) SW Methods as outlined in Subsection 6.3.4.3 of the Work Plan. The analytical laboratory used the 200-series analysis method for soils. This deviation is not considered significant since the analytical instruments used are identical, the detection limits are similar, and the method is approved by the MADEP.

- USEPA Method 8260 (SVOCs) sample extract holding time was exceeded from 4 to 8 days for all samples submitted for laboratory analysis.

## 4.4 FIELD SCREENING ACTIVITIES

During sampling of soil borings, the air around the sampler was monitored with a HNu DL-101 Data Logging Photoionization Detector (PID) immediately upon opening the sampler (to maximize the detection of volatiles). Soil was then field screened using a Photovac 10S50 Portable Gas Chromatograph (GC). The soil samples collected were placed in plastic bags, and the HNu DL-101 PID used to conduct ambient temperature headspace analysis (ATHA) for photoionization compounds. All PID readings are indicated on the boring logs included in Appendix A. The Photovac 10S50 Portable GC, calibrated to screen for benzene, toluene, ethylbenzene and xylene (BTEX), was used to detect the presence of these compounds in the headspace from the soil samples collected. Headspace analysis was used to provide immediate information as to the level of photoionizable compounds in the borehole. Data obtained from the field GC and PID will supplement analytical laboratory data. Field GC data is summarized in Subsection 5.2.1, Field GC Screening Results, and included in Appendix B.

## 4.5 CONFIRMATION ACTIVITIES

Technical Drilling Services (TDS), Inc., Clinton, Massachusetts was retained as the drilling contractor for drilling boreholes. The selected drilling contractor mobilized personnel and equipment that met or exceeded Massachusetts Air National Guard (ANG), MADEP, or other relevant regulatory requirements.

Revet Environmental & Analytical Laboratories, Inc. (REVET), Worcester, Massachusetts, was retained to perform analytical analyses. Provisions were made for proper sample containers, labels, chain-of-custody forms, sample stabilization and preservation, and insulated sample containers.

Tauper Land Survey, Whitinsville, Massachusetts was retained as the surveying contractor. The site boundaries, buildings, parking areas, and soil boring locations were surveyed. The land surface elevations of each borehole are shown on the borehole logs included in Appendix A.

### 4.5.1 Soil Borings

Soil borings were installed to obtain soil samples for analytical laboratory analysis for defining any existing soil contamination, and to aid in defining the vertical and horizontal extent of contaminants at the site. Soil samples were also used for determining site geology and subsurface soil characteristics.

A total of 15 soil borings, including background, were drilled for data collection. All work was performed in a manner consistent with MADEP regulations. Depth of the soil test borings were limited to the depth where granitic bedrock was encountered. Seven borings were drilled using hollow-stem auger (HSA) methods, and eight borings were drilled using a hand auger, to collect samples.

#### 4.5.1.1 Hollow-Stem Auger Boreholes

The HSA drilling method employs a hollow helical steel drill tool that is rotated to advance the boring and lift formation materials (cuttings) to the surface. The flights for the HSA are welded onto steel pipe and a cutter head is attached to the "lead" (bottom) auger to cut the hole. During drilling, a center bit is inserted into the hollow area of the cutter head that prevents cuttings from re-entering the hollow portion of the auger. Generally, the center bit is flush with or extends no more than 1/2 foot below the cutter head. The center bit connects through the auger

by small diameter drill rods and is attached to the top-head drive unit of the drill rig. The top-head drive is powered by a truck-mounted engine that mechanically rotates the entire flight of augers. The hollow opening allows the insertion of sampling tools (i.e., split-spoon sampler) with the augers in place to prevent caving of the borehole.

Soil samples were collected below the asphalt surface and above the bedrock for subsurface characterization and field screening. An 18-inch carbon steel California-style sampler equipped with three 6-inch brass sleeves was used for collecting soil samples for laboratory analysis. Actual sample depths submitted for laboratory analysis are discussed in Subsection 5.2.2.3, Nature and Extent of Soil Contamination, and shown on the borehole logs included in Appendix A. The California-style sampler was decontaminated and new brass sleeves inserted before each sampling event.

Auger flights, drill rig(s), and tools were thoroughly steam-cleaned in the designated decontamination area at the northwest end of Building 2 before initial use and after the completion of each borehole.

Borehole abandonment activities conformed to applicable Massachusetts requirements. HSA borings were backfilled with pure bentonite grout immediately after the sampling had been accomplished to prevent the downward migration of contaminants through the open borehole. The hand auger boring locations were not grouted since the borings were only 1 foot deep and the surrounding soils closed on the borehole when the auger was retrieved.

Soil boring locations and ground elevation were determined by a professional surveyor.

#### 4.5.1.2 Hand Auger Boreholes

A stainless steel 2-inch inside diameter (ID) hand auger was used to perform drilling and sampling for the eight soil borings drilled outside the perimeter fence. The hand auger consisted of a hollow drilling bit, extensions for depths to 6 feet, and a "T" handle to drive the sampler. A hollow sampling bit which holds brass sleeves was used to retrieve soil samples for field screening and laboratory analyses. The auger is retrieved and the drilling bit replaced by the sampling bit when the drilling activity reached depths at which the sample was desired.

The sampling bit of the hand auger holds two 5-inch brass sleeves used tc contain the soil samples. Sufficient volume of soil was recovered at each sampling interval to meet analytical testing requirements outlined in the Work Plan. The actual sample depths submitted for

laboratory analysis are discussed in Subsection 5.2.2.3, Nature and Extent of Soil Contamination, and shown on the borehole logs included in Appendix A. The hand auger extensions, drilling, and sampling bits were decontaminated and new brass sleeves inserted before each sampling event.

### 4.5.2 Specific Media Sampling

This subsection summarizes the analytical program followed for soil samples collected during the Site Investigation to determine the nature, magnitude, and extent of contamination detected at the site. Also included in this subsection is a brief discussion of quality control procedures followed during the field sampling activities.

#### 4.5.2.1 Soil

Past activities at the site indicate that suspected contamination consists primarily of waste oil, organic solvents, and fuels (diesel, MOGAS, JP-4 and JP-5). Therefore, the primary analytical program of the SI focused on the detection of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and lead.

To comply with MADEP requirements, and to fulfill the requirements of the SI, soil samples were analyzed for VOCs using Method SW8240; SVOCs by Method SW8270; priority pollutant metals by Method 200.7 with the exception of arsenic (206.2), mercury (245.5), selenium (270.2), and thallium (279.2); TPH by Method 418.1; and polychlorinated biphenyls (PCBs) by Method SW8080.

Table 4.1 summarizes the analytical program at the 15 borehole locations designed to detect suspected contaminants at the site.

#### 4.5.2.2 Quality Control Of Field Sampling

Field duplicate samples, field blanks, and trip blanks were submitted to the analytical laboratory for assessment of the quality of data resulting from the field sampling program. Field and trip blank samples were analyzed to check for procedural contamination and ambient conditions at the site that may have caused sample contamination. Duplicate samples were submitted to provide a quality assurance check on analytical procedures and results.

## Table 4.1
## Laboratory Analyses Summary Table for Site Related Contaminants
## 101st ACS, Worcester ANGS, Worcester, Massachusetts

| Site No. | Matrix | Field Parameters | Lab Parameters | Analytic Methods | Investigating Samples | Number of Field QA/QC Samples | | | | | Matrix Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Trip Blanks | Equipment Blanks | Field Blanks | Field Duplicate | MS/ MSD | |
| 1 | Soil | Soil Gas Screening using HNu PID<br>Field GC<br>Soil Classification | VOC<br>SVOC<br>TPH<br>Metals<br>PCBs | SW 8240[a]<br>SW 8270[a]<br>418.1<br>200.7[b]<br>SW 8080[a] | 21 | 4* | 3 | 3 | 3 | 2 | 32 |

*Trip Blanks are not counted in Matrix Totals.
VOC – Volatile Organic Compounds.
SVOC – Semivolatile Organic Compounds.
TPH – Total Petroleum Hydrocarbons/USEPA 600/418.1.
PCBs – Polychlorinated Biphenyls.

MS/MSD – Matrix Spike, Matrix Spike Duplicate.
[a]USEPA 1986.
[b]With the exception of arsenic (206.2), mercury (245.5), selenium (270.2), and thallium (279.2).

The level of the quality control effort included one field duplicate for every 10 or fewer investigative soil samples, and one field duplicate and one field blank for every 10 or fewer investigative water samples. One VOC analysis trip blank, consisting of distilled, de-ionized, ultra pure water, was included along with each shipment of samples. One matrix spike/matrix spike duplicate was collected for every 20 or fewer investigative soil samples. Matrix samples provide information about the effect of the sample matrix on the analytical methodology.

#### 4.5.2.3 Soil Sample Preservation

Soil samples submitted for laboratory analysis collected with a California-style sampler and a hand auger were contained in brass sleeves. Immediately upon removal from the sampler, the sleeve ends were covered with a teflon barrier, aluminum foil and fitted with a plastic cap. The plastic caps were then secured with duct tape. Prepared samples were placed in a sealed zip-lock plastic bag and immediately placed in the ice chest.

Equipment blanks and field blanks were collected as aqueous samples. VOC samples were preserved with no more than 2 drops of a 1:1 solution of hydrochloric acid per 40-milliliter glass Volatile Organic Analysis (VOA) vial having a teflon-lined lid. SVOC samples were stored in a 1-liter amber glass bottles having teflon-lined lids, and no preservatives. Total recoverable metal samples were stored in a 1/2-liter high-density polyethylene bottle with a teflon-lined lid, and preserved with a solution of 1:1 nitric acid to achieve a pH of less than 2. TPH and PCB samples were stored in two 1-liter amber glass bottles having teflon-lined lids, and no preservatives.

### 4.6 INVESTIGATION DERIVED WASTE

During the SI, a certain amount of waste material (personal protective equipment (PPE), drill cuttings and purge water) were produced as a result of investigative activities. Drill cuttings were produced during the installation of soil borings. Drill cuttings were preliminarily characterized by monitoring for organic vapor emissions with a HNu DL-101 PID and screening with a Photovac 10S50 Portable GC. Nonetheless, all soil cuttings were drummed in steel, plastic-lined 55-gallon drums at the time of drilling.

Miscellaneous derived wastes (e.g., gloves, visqueen sheeting, and wipes) which came in contact with drill cuttings having PID readings less than 100 parts per million (ppm), when field-screened as described in Section 4.4, were disposed of in a general refuse container.

All drums were properly marked to indicate their contents, the collection date, contractor's name and telephone number, and borehole identification number. The final disposition of drummed materials is discussed in Appendix H of this report.

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## SECTION 5.0 INVESTIGATIVE FINDINGS

### 5.1 BACKGROUND

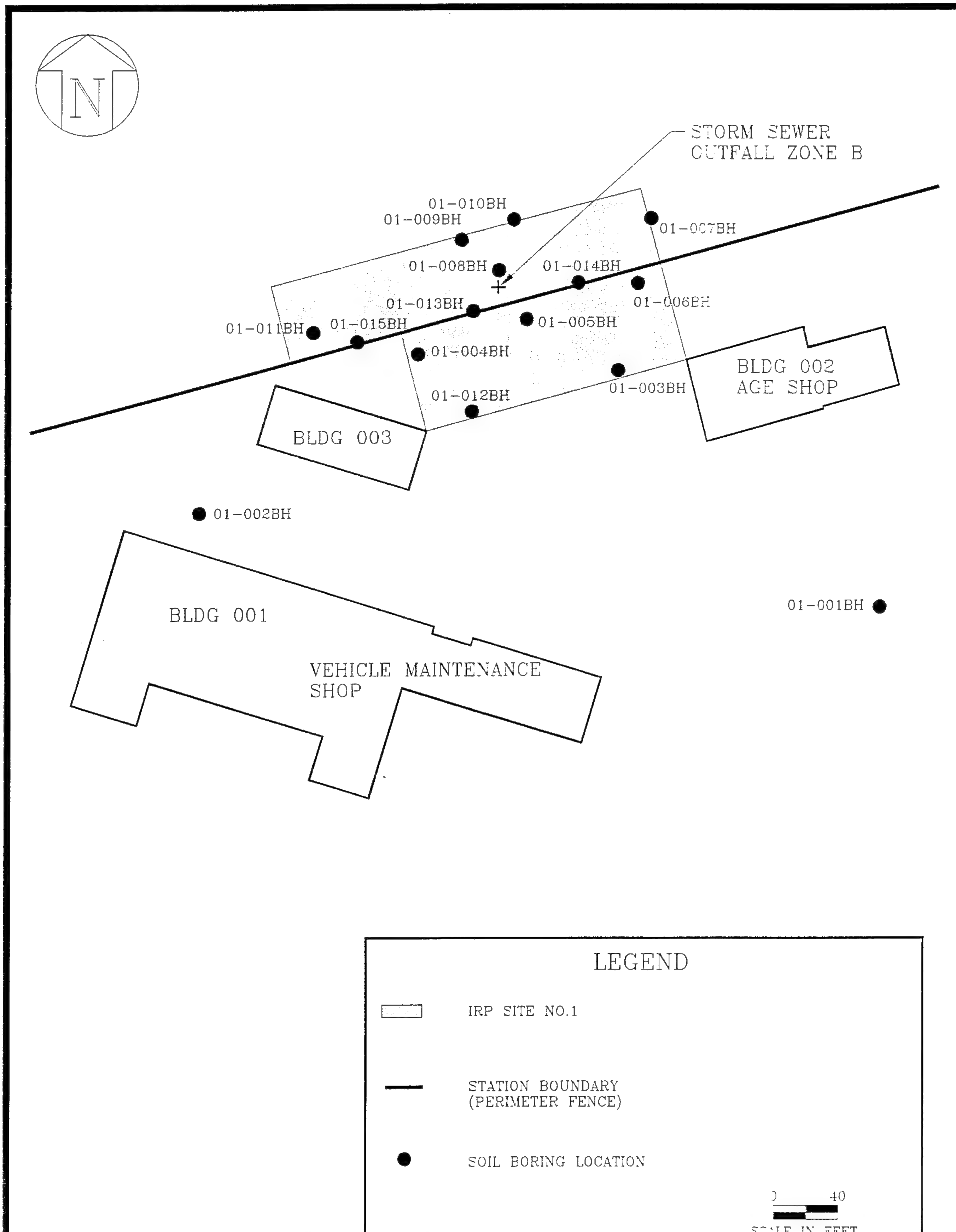
#### 5.1.1 Background Sampling Locations and Results

Background data during the SI at Worcester ANGS consisted of two soil borings, 01-001BH and 01-002BH, which were used to obtain soil samples. The locations chosen for background sampling were away from known areas of contamination and were located upgradient of the site. Soil boring 01-001BH is located approximately 160 feet southeast of the site and to the south of Building 002, as indicated on Figure 5.1. Soil boring 01-002BH is located approximately 150 feet southwest of the site and to the north of Building 001 (Figure 5.1). Field screening of soil samples collected during drilling indicated no evidence of contamination at either background boring location.

After field activities were concluded, however, the oil/water separator located north of Building 1 (Tank #1-4) was determined to be a dry well and was identified to be a possible source of contamination (Figure 2.3). Also, during the removal of USTs at the Station, additional contamination was found to exist. Background boring 01-002BH is downslope and immediately west of these areas. Considering these confirmed sources of contamination in close proximity to this background boring, 01-002BH should not be considered a reliable source of background environmental conditions at the Station.

Soil samples were collected for laboratory analysis from background locations to determine naturally occurring concentration levels, and contaminant or chemical concentrations already existing in the area due to general environmental conditions. Analytical results obtained during this sampling represent background conditions against which contaminant concentrations detected at the site will be compared and the significance of detected contamination determined.

Soil boring 01-001BH was drilled and a soil sample collected on 16 November 1993. Soil boring 01-001BH was drilled and sampled to a depth of 2.0 feet BLS where bedrock was encountered. The soil was a coarse- to medium-grained quartz sand (possibly fill material) with abundant, well-rounded gravel. No saturated conditions were encountered at this borehole. Soil boring 01-002BH was drilled and a soil sample collected on 16 November 1993. Soil boring 01-002BH was drilled to a depth of 2.7 feet BLS. Fill material, consisting of coarse- to medium-grained quartz sand and rounded to angular gravel, was encountered. Saturated conditions were not encountered at this borehole location.




SOURCE: TAUPER SURVEY, 1993.

| | | |
|---|---|---|
| FIGURE 5.1<br>WORCESTR\SBOR-LOC | SOIL BORING LOCATIONS<br>AT IRP SITE NO.1<br>101st ACS and 212th EIS<br>Worcester Air National Guard Station<br>Worcester, Massachusetts | OPTECH<br>OPERATIONAL TECHNOLOGIES CORPORATION<br>JANUARY 1995 |

Two investigative soil samples (one from each boring), were collected for laboratory analysis. Sampling depths and the analytical program are indicated on Table 5.1.

**Table 5.1**
**Background Soil Sampling and Analytical Program**
**101st ACS, Worcester ANGS, Worcester, Massachusetts**

| Borehole Number | Sample Depth (Ft BLS) | Soil Analyses and Methods | | | | |
|---|---|---|---|---|---|---|
| | | VOCs (SW8240) | SVOCs (SW8270) | TPH (418.1) | Metals (200.7)[a] | PCBs (SW8080) |
| 01-001BH | 0.5 - 2.0 | X | X | X | X | X |
| 01-002BH | 0.5 - 2.0 | X | X | X | X | X |

[a]With the exception of Arsenic (206.2), Mercury (245.5), Selenium (270.2), and Thallium (279.2).
BH – Borehole.
VOCs – Volatile Organic Compounds.
SVOCs – Semivolatile Organic Compounds.
TPH – Total Petroleum Hydrocarbons.
PCBs – Polychlorinated Biphenyls.
X – Indicates parameter was analyzed.

Validity of the background sampling concerning the volatile fraction were within acceptable quality control limits. No analytical problems were encountered among the analyses, and all surrogate and MS/MSD recoveries met quality control criteria. Semivolatile samples remain valid among surrogate and MS/MSD recovery quality assurance criteria except for background sample 01-002BH INT 1. This sample had three out of eight surrogate recoveries out of quality control limits. These values for this sample indicate that the true values for those analytes of interest may be 20 to 30 percent less than the values reported. The validity of PCB, TPH, and metals analyses were all within acceptable quality assurance criteria among surrogate and matrix spike recoveries.

Quality assurance/quality control sample analytical results are reported in Appendix C. A complete listing of the results for all analytical parameters for each sample is given in Appendix D.

Soil sample analysis of 01-001BH and 01-002BH indicated no detected VOCs, SVOCs, or PCBs at either boring location. TPH was not found above detection limits (DLs) at 01-001BH, but was detected in 01-002BH at 92 milligrams per kilogram (mg/kg).

Metals analysis indicated eight metals of the 13 were detected in each boring in excess of the DLs. Boreholes 01-001BH and 01-002BH analyses indicated levels of arsenic (10 milligrams

per kilogram (mg/kg) DL) at 36 mg/kg and 67 mg/kg; beryllium (0.1 mg/kg DL) at 0.2 mg/kg and 0.3 mg/kg; chromium (0.9 mg/kg DL) at 18 mg/kg and 19.3 mg/kg; copper (0.3 mg/kg DL) at 36 mg/kg and 45.4 mg/kg; lead (5 mg/kg DL) at 20 mg/kg and 9.1 mg/kg; nickel (2 mg/kg DL) at 21 mg/kg and 29 mg/kg; thallium (0.1 mg/kg DL) at 0.2 mg/kg and 0.2 mg/kg; and zinc (0.3 mg/kg DL) at 53.2 mg/kg and 50.7 mg/kg, respectively.

Table 5.2 summarizes the analytes detected in soil samples collected from background locations. A complete listing of the results for all analytical parameters for each sample is given in Appendix D.

**Table 5.2**
**Analytes Detected in Background Soil Samples**
**101st ACS, Worcester ANGS, Worcester, Massachusetts**

| Component | Detection Limit (mg/kg) | 01-001BH (mg/kg) | 01-002BH (mg/kg) | Analytical Method | Massachusetts State Reportable Concentrations* (mg/kg) |
|---|---|---|---|---|---|
| TPH | 40.0 | <40.0 | 92.0 | 418.1 | 2,500.0 |
| Metals: | | | | | |
| Antimony | 10.0 | <10.0 | <10.0 | 200.7 | 40.0 |
| Arsenic | 0.4 | 36.0 | 67.0 | 206.2 | 30.0 |
| Beryllium | 0.1 | 0.2 | 0.3 | 200.7 | 0.8 |
| Cadmium | 0.4 | <0.4 | <0.4 | 200.7 | 80.0 |
| Chromium | 0.9 | 18.0 | 19.3 | 200.7 | 2,500.0 |
| Copper | 0.3 | 36.0 | 45.4 | 200.7 | 10,000.0 |
| Lead | 5.0 | 20.0 | 9.1[a] | 200.7 | 600.0 |
| Mercury | 0.1 | <0.1 | <0.1 | 245.5 | 60.0 |
| Nickel | 2.0 | 21.0 | 29.0 | 200.7 | 700.0 |
| Selenium | 0.5 | <0.5 | <0.5 | 270.2 | 2,500.0 |
| Silver | 0.4 | <0.4 | <0.4 | 200.7 | 200.0 |
| Thallium | 0.1 | 0.2 | 0.2 | 279.2 | 30.0 |
| Zinc | 0.3 | 53.2 | 50.7 | 200.7 | 2,500.0 |

[a]Method 239.2, DL – 0.1 mg/L.
BH – Borehole.
TPH – Total Petroleum Hydrocarbons.
mg/kg – milligrams per kilogram.
NA – Data Not Available.
*Massachusetts Contingency Plan.

## 5.2 SITE FINDINGS

IRP Site No. 1 is located along the north perimeter fence between Building 003 and Building 002. The southern boundary of the site extends from the northeast corner of Building 003 (Storage Building) to the northwest corner of Building 002 (AGE Shop). The site extends to the north approximately 30 feet beyond the northwest perimeter fence. The north boundary of the site parallels the fence line. The Old Embankment extended from the northwest corner of Building 002 to the northeast corner of Building 003 until the 1970s and early 1980s,

at which time the low area located between the embankment and current fence line was filled in with construction debris. The site extends to the base of the current embankment which parallels the northern fence line. A portion of the site lies outside of the fence line, extending approximately 40 feet to the southwest to include a portion of the current embankment (Figure 2.2).

The portion of the site within the Station boundary (south of the fence) is asphalt paved and used as a parking area for vehicles and AGE equipment. The portion of the site north of the fence slopes down sharply for approximately 10 feet, indicating the end of the fill embankment, and extends into undeveloped city park woodlands. The embankment fill is estimated to be 6 to 8 feet thick.

No permanent structures or underground storage tanks are located within the boundaries of the site. An overhead power line, not in service during the SI, is located along the fence line. Storm drainage systems run under portions of the site (Figure 2.3) but did not affect the conduct of the investigation.

### 5.2.1 Field Activities Results

A total of 20 soil samples were field screened with a Photovac 10S55 Portable GC. The GC was calibrated to screen for BTEX. Table 5.3 summarizes the maximum concentrations detected in soil samples. Complete GC data is included in Appendix B.

Total BTEX was detected at concentrations ranging from 6.69 parts per billion (ppb) to 77.44 ppb in seven of the 20 soil samples analyzed, benzene from 6.5 ppb to 17.03 ppb in three of the samples, toluene from 14.5 ppb to 23.1 ppb in four of the samples, ethylbenzene at 39.88 ppb in one of the samples, and xylene at 37.86 ppb in one of the samples. The highest concentrations were detected in the soil samples collected from soil boring 01-012BH, located along the southern portion of the site. The highest concentrations of total BTEX, ethylbenzene, and xylene were detected in the soil sample collected from 01-012BH at a depth of 5.5 to 7.0 feet BLS immediately above the bedrock surface. The highest concentration of benzene was detected in the soil sample collected from soil boring 01-005BH at a depth of 6.0 to 7.5 feet BLS, while the highest concentration of toluene was detected in the soil sample collected from 01-015BH at a depth of 6.0 to 7.5 feet BLS. Table B.1 in Appendix B presents the field GC data summary.

**Table 5.3**
**Maximum GC Concentrations Detected in Soil Samples**
**101st ACS, Worcester ANGS, Worcester, Massachusetts**

| Compound | Maximum Concentrations Detected in Soil Samples (ppb) |
|---|---|
| Benzene | 17.03 |
| Toluene | 23.10 |
| Ethylbenzene | 39.88 |
| Xylene | 37.86 |

Soil concentrations area adjusted soil weight data.
GC – Gas Chromatograph.
ppb – parts per billion.

During sampling, insufficient recovery from 01-008BH did not provide a sample for GC screening.

### 5.2.2 Soils

Soil samples collected from the 15 soil borings were used to provide geologic information for describing the subsurface geology at the Station and for the site. Twenty-one investigative soil samples were submitted for laboratory analysis to provide an assessment of the presence and type of soil contamination present.

#### 5.2.2.1 Soil Boring Locations

Fifteen soil borings were installed at the site to obtain soil samples for laboratory analysis for defining any existing soil contamination, to aid in defining the vertical and horizontal extent of contamination, and to determine soil background conditions. Soil samples were also used for characterizing site geology and subsurface soil conditions (see Figure 5.1). All soil borings were drilled in their originally proposed locations as specified in the SI Work Plan. Three soil borings, 01-013BH, 01-014BH, and 01-015BH, were added to the investigation at the direction of the ANGRC/CEVR Project Manager. These soil borings were located along the north side of the perimeter fence to better characterize soils and to identify potential contamination where waste oil, organic solvents, and fuels were disposed for weed control.

Soil borings 01-001BH and 01-002BH were located upslope of the site and away from known contamination source areas to obtain background samples as described in Subsection 5.1.1.

Soil borings 01-004BH, 01-005BH, and 01-006BH were located immediately south of the perimeter fence, and 01-013BH, 01-014BH, and 01-015BH were located immediately north of the perimeter fence to confirm or deny the presence of contamination associated with the use of wastes in weed control along the perimeter fence, and contamination associated with small fuel spills from mobile generators parked along the southwest portion of the site.

Soil borings 01-003BH and 01-012BH were located in the southernmost portion of the site to determine if contamination is present from activities associated with the Old Waste Holding Area at the east and south portions of the site. These borings also provide information concerning the southern lateral extent of contamination.

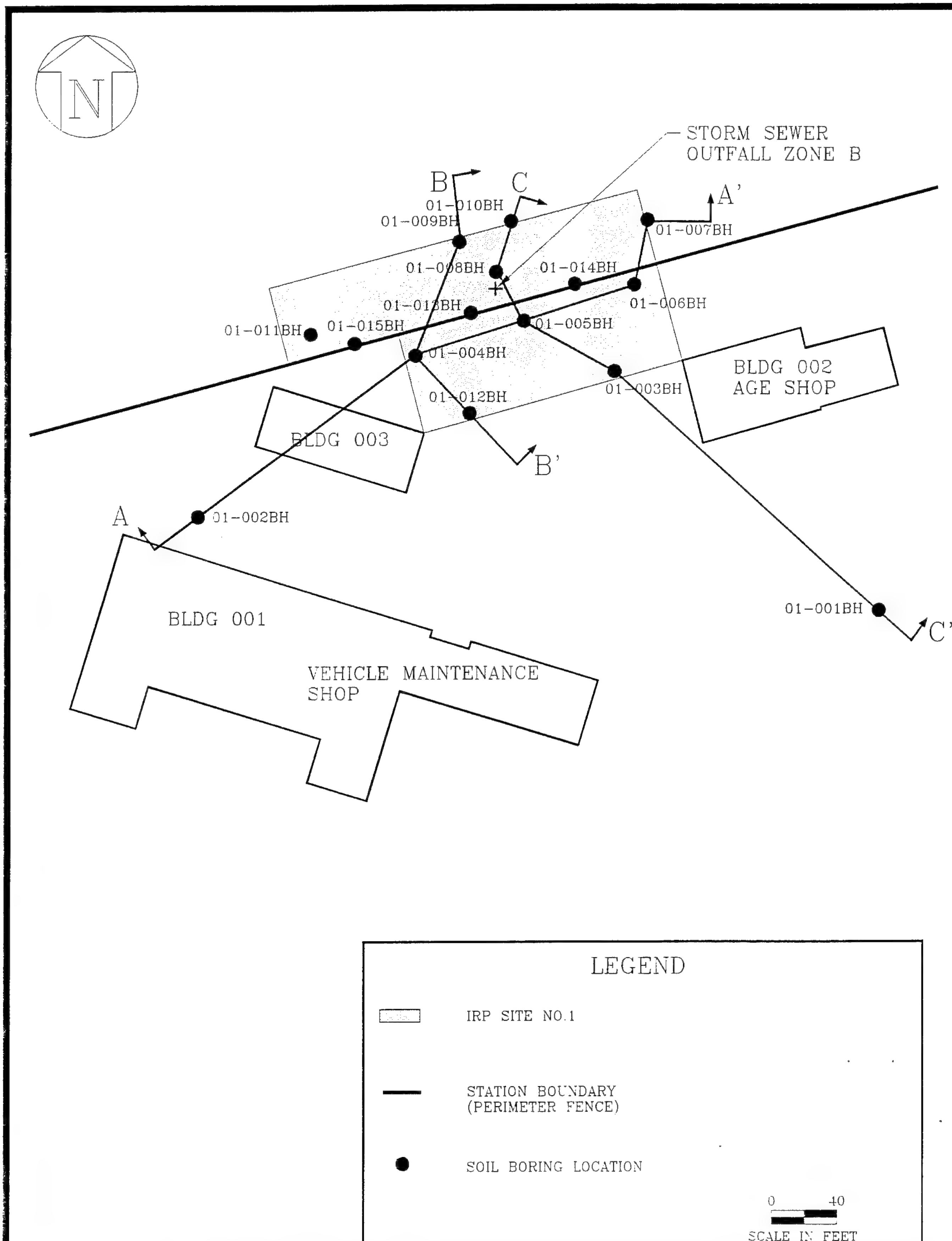
Soil borings 01-007BH, 01-009BH, 01-010BH, and 01-011BH were located to determine if contamination has occurred at the site as a result of past waste disposal along the old embankment and to provide information on the lateral extent of contamination downslope of the site.

Soil boring 01-008BH was located at Storm Sewer Outfall B, the location where the oil/water separator, which connected to floor drains in the Vehicle Maintenance Shop, once discharged. The storm sewer outfall now discharges storm runoff collected from the northern portion of the Station. Since the storm sewer outfall is located in a topographically low area, surface runoff from the parking areas collects and also flows through the storm sewer outfall channel.

#### 5.2.2.2 Subsurface Geology

Soil samples collected from soil borings (including the background soil borings) were used to provide geologic information for describing the subsurface geology at the Station and for the site. Complete lithologic logs for the holes drilled during this investigation are presented in Appendix A.

The soil beneath the parking areas and the embankment is predominantly fill material graded from nearby existing soil. Fill material consisted of a coarse- to medium-grained quartz sand with well rounded to subangular gravel. Unsorted sand, silt, and clay was encountered above the bedrock surface. The soil horizon thickens northward from a thickness of 2.0 to 2.5 feet at the background borings to a maximum thickness of 7.75 feet along the perimeter fence. Soil thicknesses below the embankment, measured at boreholes 01-009BH and 01-010BH, were usually less than 1 foot in thickness with bedrock exposures common. Cross-sections depicting the subsurface geology are indexed in Figure 5.2 and shown in Figures 5.3, 5.4, and 5.5.




SOURCE: TAUPER SURVEY, 1993.

FIGURE 5.2

GEOLOGIC CROSS-SECTION
LOCATION MAP
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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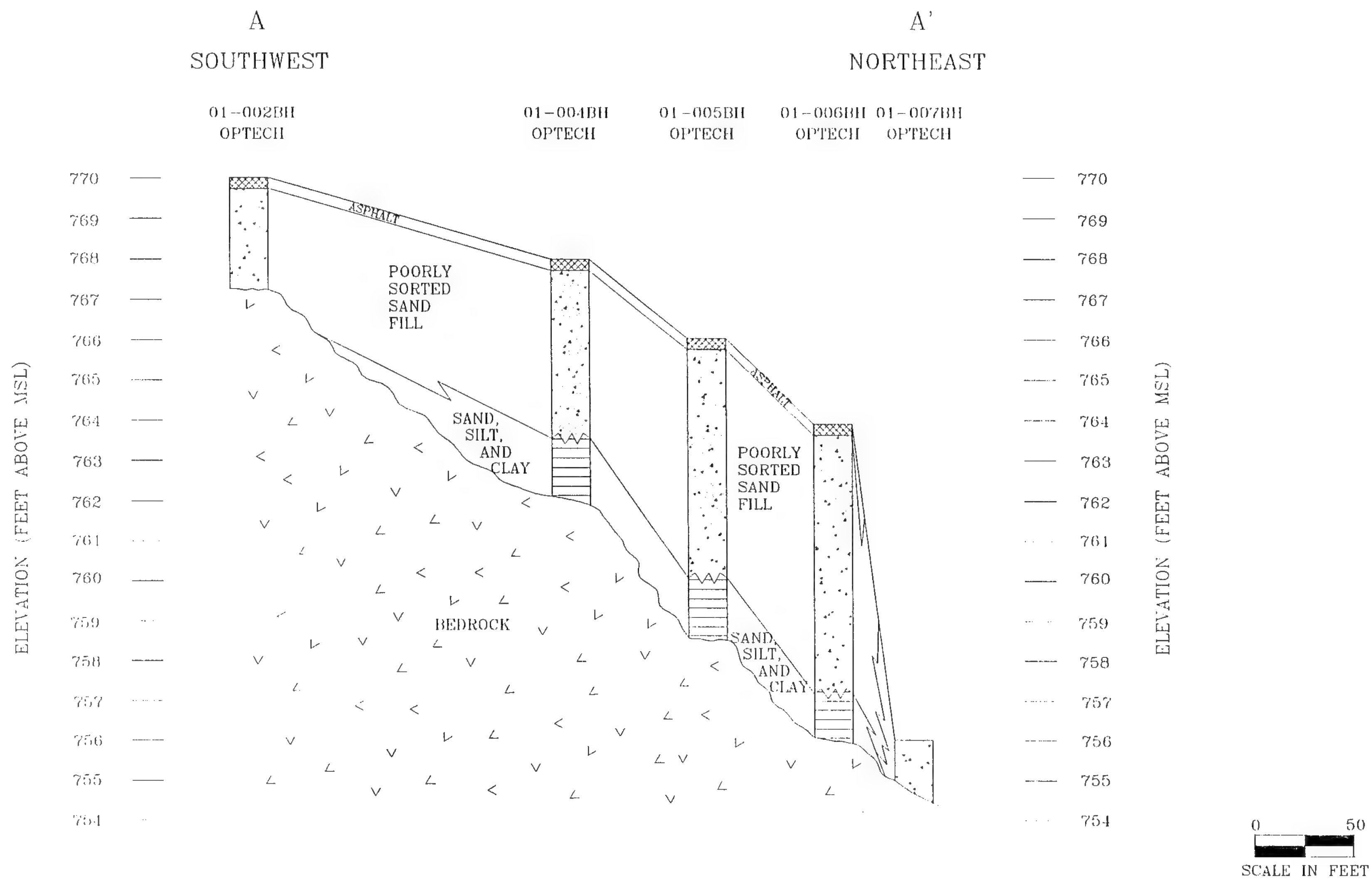


FIGURE 5.3

WORCESTER\CROSS AA

GEOLOGIC CROSS SECTION A-A'
101st ACS and 212th EIS
Worcester Air National Guard
Worcester, Massachusetts

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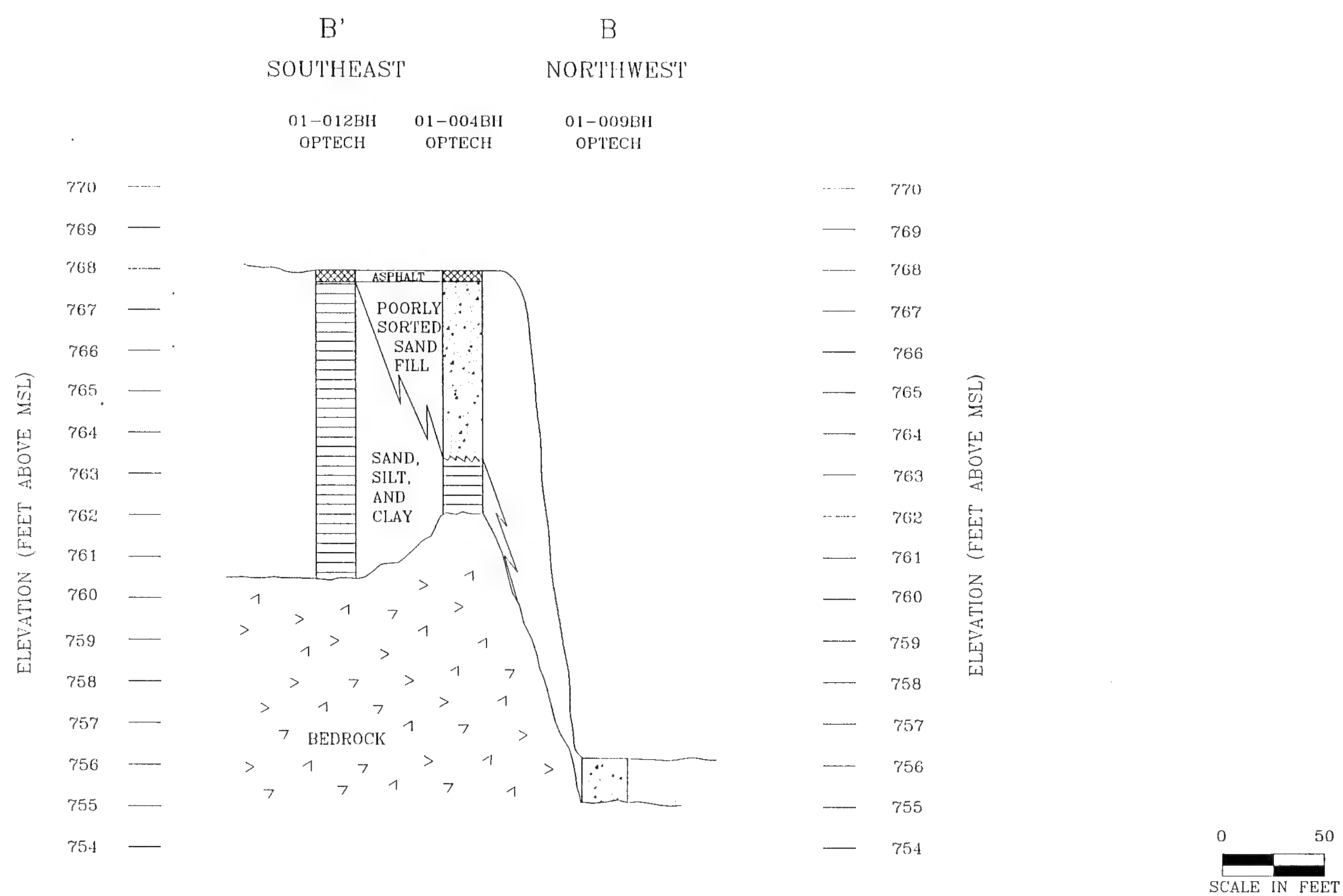


FIGURE 5.4

WORCESTER\CROSS-BB

GEOLOGIC CROSS SECTION B-B'
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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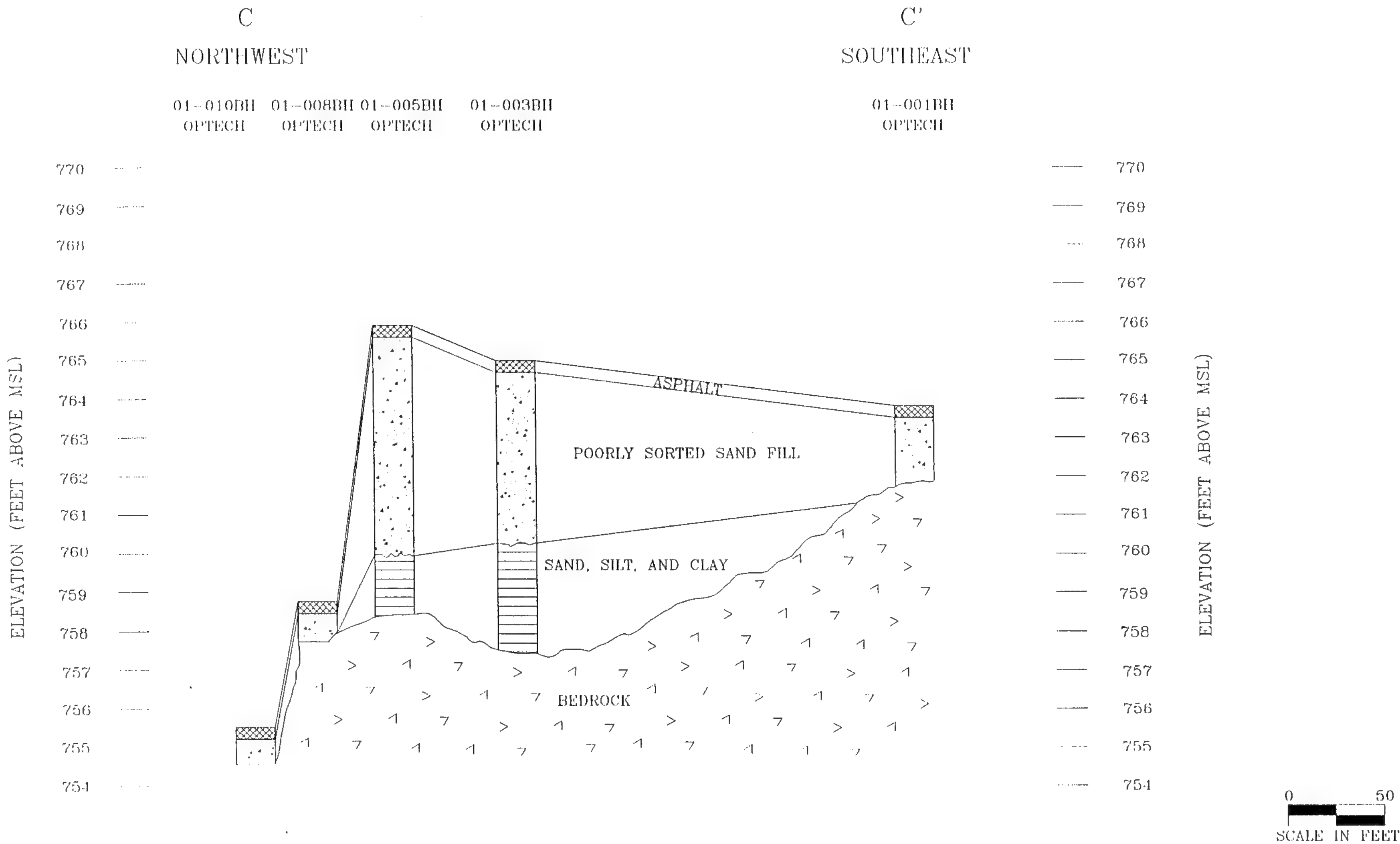


# FIGURE 5.5

WORCESTER\CROSS-CC

## GEOLOGIC CROSS SECTION C-C'

101st ACS and 212th EIS
Worcester Air National Guard
Worcester, Massachusetts

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### 5.2.2.3 Nature and Extent of Soil Contamination

Fifteen soil borings were drilled at the site from which 21 investigative and three duplicate soil samples were collected for laboratory analysis. The borings were drilled and soil samples collected from 16 November to 18 November 1993. Sampling intervals submitted for laboratory analysis and the analytical program are presented in Table 5.4.

Validity of IRP Site No. 1 samples concerning volatile and semivolatile fractions were all within acceptable quality control limits. All volatile and semivolatile surrogate and MS/MSD recoveries met quality control criteria. No analytical problems were encountered among the sample and quality assurance/quality control analyses. The validity of PCB, TPH and metals analyses were all within acceptable quality assurance criteria among surrogate and matrix spike recoveries.

Quality assurance/quality control sample analytical results are reported in Appendix C. A complete listing of the results for all analytical parameters for each sample is given in Appendix D.

#### 5.2.2.3.1 VOC Contamination

VOCs detected in soil samples collected at IRP Site No. 1 are shown in Table 5.5. Of the 21 intervals analyzed for VOCs, five samples had detectable levels of VOCs.

Acetone was detected in four of the samples at concentrations ranging from 65 micrograms per kilogram ($\mu$g/kg) to 220 $\mu$g/kg. The highest concentration was in boring 01-006BH (7.0 - 7.75 feet BLS) at 220 $\mu$g/kg. Acetone was also detected at borings 01-005BH (6.0 - 7.5 feet BLS), 01-004BH (5.0 - 5.9 feet BLS), and 01-012BH (0.0 - 1.0 feet BLS) at concentrations of 110 $\mu$g/kg, 78 $\mu$g/kg, and 65 $\mu$g/kg, respectively.

Toluene was detected in only two samples. Borings 01-005BH (6.0 - 7.5 feet BLS) and 01-006BH (7.0 - 7.75 feet BLS) had detected levels of toluene at 8 $\mu$g/kg and 6 $\mu$g/kg, respectively.

The only other VOC compounds detected were 2-butanone (also known as methyl ethyl ketone (MEK)), which was detected in 01-006BH (7.0 - 7.75 feet BLS) at 50 $\mu$g/kg, and total xylenes, which was detected in 01-012BH (5.5 - 7.0 feet BLS) at 2,000 $\mu$g/kg.

## Table 5.4
## Soil Sampling and Analytical Program
## 101st ACS, Worcester ANGS, Worcester, Massachusetts

| Borehole Number | Sample Depth (Ft BLS) | Additional Samples | Soil Analyses and Methods: VOCs (SW8240) | SVOCs (SW8270) | TPH (418.1) | PCBs (SW8080) | Metals (200.7)[a] |
|---|---|---|---|---|---|---|---|
| 01-001BH | 0.5 - 2.0 | | X | X | X | X | X |
| 01-002BH | 0.5 - 2.0 | | X | X | X | X | X |
| 01-003BH | 0.5 - 2.0 | | X | X | X | X | X |
| 01-003BH | 7.0 - 7.75 | | X | X | X | X | X |
| 01-004BH | 0.5 - 2.0 | | X | X | X | X | X |
| 01-004BH | 5.0 - 5.9 | | X | X | X | X | X |
| 01-005BH | 0.5 - 2.0 | | X | X | X | X | X |
| 01-005BH | 6.0 - 7.5 | | X | X | X | X | X |
| 01-006BH | 4.0 - 5.5 | | X | X | X | X | X |
| 01-006BH | 7.0 - 7.75 | | X | X | X | X | X |
| 01-007BH | 0.0 - 1.0 | | X | X | X | X | X |
| 01-007BH | 0.0 - 1.0 | Duplicate | X | X | X | X | X |
| 01-007BH | 0.0 - 1.0 | MS/MSD | X | X | X | X | X |
| 01-007BH | 1.0 - 2.0 | | X | X | X | X | X |
| 01-008BH | 0.0 - 1.0 | | X | X | X | X | X |
| 01-009BH | 0.0 - 1.0 | | X | X | X | X | X |
| 01-010BH | 0.0 - 1.0 | | X | X | X | X | X |
| 01-011BH | 0.0 - 1.0 | | X | X | X | X | X |
| 01-011BH | 0.0 - 1.0 | Duplicate | X | X | X | X | X |
| 01-012BH | 0.5 - 2.0 | | X | X | X | X | X |
| 01-012BH | 5.5 - 7.0 | | X | X | X | X | X |
| 01-013BH | 0.5 - 1.5 | | X | X | X | X | X |
| 01-014BH | 0.5 - 1.5 | | X | X | X | X | X |
| 01-015BH | 0.0 - 1.0 | | X | X | X | X | X |
| 01-015BH | 0.0 - 1.0 | Duplicate | X | X | X | X | X |
| 01-015BH | 0.0 - 1.0 | MS/MSD | X | X | X | X | X |
| | | Equip. Blank (3) | X | X | X | X | X |
| | | Field Blank (3) | X | X | X | X | X |
| | | Trip Blank (4) | X | N | N | N | N |

[a]With the exception of Arsenic (206.2), Mercury (245.5), Selenium (270.2), and Thallium (279.2).

BH – Borehole.
VOCs – Volatile Organic Compounds.
SVOCs – Semivolatile Organic Compounds.
PCBs – Polychlorinated Biphenyls.
X – Indicates parameter was analyzed.
TPH – Total Petroleum Hydrocarbons.
MS – Matrix Spike.
MSD – Matrix Spike Duplicate.
N – Indicates analysis was not run.

**Table 5.5**
**Volatile Organic Compounds Detected in Soil Samples**
**101st ACS, Worcester ANGS, Worcester, Massachusetts**

| Sample ID Number | Sample Depth (Ft BLS) | Acetone ($\mu$g/kg) | Toluene ($\mu$g/kg) | 2-Butanone (MEK) ($\mu$g/kg) | Total Xylenes ($\mu$g/kg) |
|---|---|---|---|---|---|
| 01-004BH | 5.0 - 5.9 | 65 | ND (6) | ND (12) | ND (6) |
| 01-005BH | 6.0 - 7.5 | 110 | 8 | ND (12) | ND (6) |
| 01-006BH | 7.0 - 7.75 | 220 | 6 | 50 | ND (6) |
| 01-012BH | 0.0 - 1.0 | 78 | ND (5) | ND (10) | ND (6) |
| 01-012BH | 5.5 - 7.0 | ND (550) | ND (280) | ND (550) | 2,000 |

$\mu$g/kg – micrograms per kilogram.
BH – Borehole.
ND – Not Detected above DLs. Number indicates detection limit.

### 5.2.2.3.2 SVOC Contamination

SVOC contamination was detected in 15 of the 21 soil samples submitted for analysis. Eight of these 15 samples indicated individual compound concentrations above detection limits. Table 5.6 lists the borehole and sample intervals where SVOCs were detected. Additionally, two field duplicates and two laboratory method blanks contained detectable levels of SVOC contamination and are also listed. SVOC analytical results for all investigative samples are listed in Appendix D. Quality control sample results are listed in Appendix C.

Six samples, including one duplicate and one laboratory method blank, indicated SVOC contamination above detection limits. Three soil borings (01-005BH (6.0 - 7.5 feet BLS), 01-003BH (0.5 - 2.0 feet BLS), and 01-012BH (0.5 - 2.0 feet BLS)) contained the highest number of individual compounds detected and the highest concentration of those compounds (Table 5.6).

Borehole 01-005BH (6.0 - 7.5 feet BLS) indicated the highest concentrations of phenanthrene (11,000 $\mu$g/kg), fluoranthene (15,000 $\mu$g/kg), pyrene (16,000 $\mu$g/kg), benzo(a)anthracene (6,600 $\mu$g/kg), chrysene (6,300 $\mu$g/kg), benzo(b)fluoranthene (5,200 $\mu$g/kg), benzo(k)fluoranthene (5,300 $\mu$g/kg), and benzo(a)pyrene (5,900 $\mu$g/kg). Each of these compounds was detected in lesser concentrations in 01-003BH (0.5 - 2.0 feet BLS) and 01-012BH (0.5 - 2.0 feet BLS). Pyrene contamination per borehole is shown in Figure 5.6.

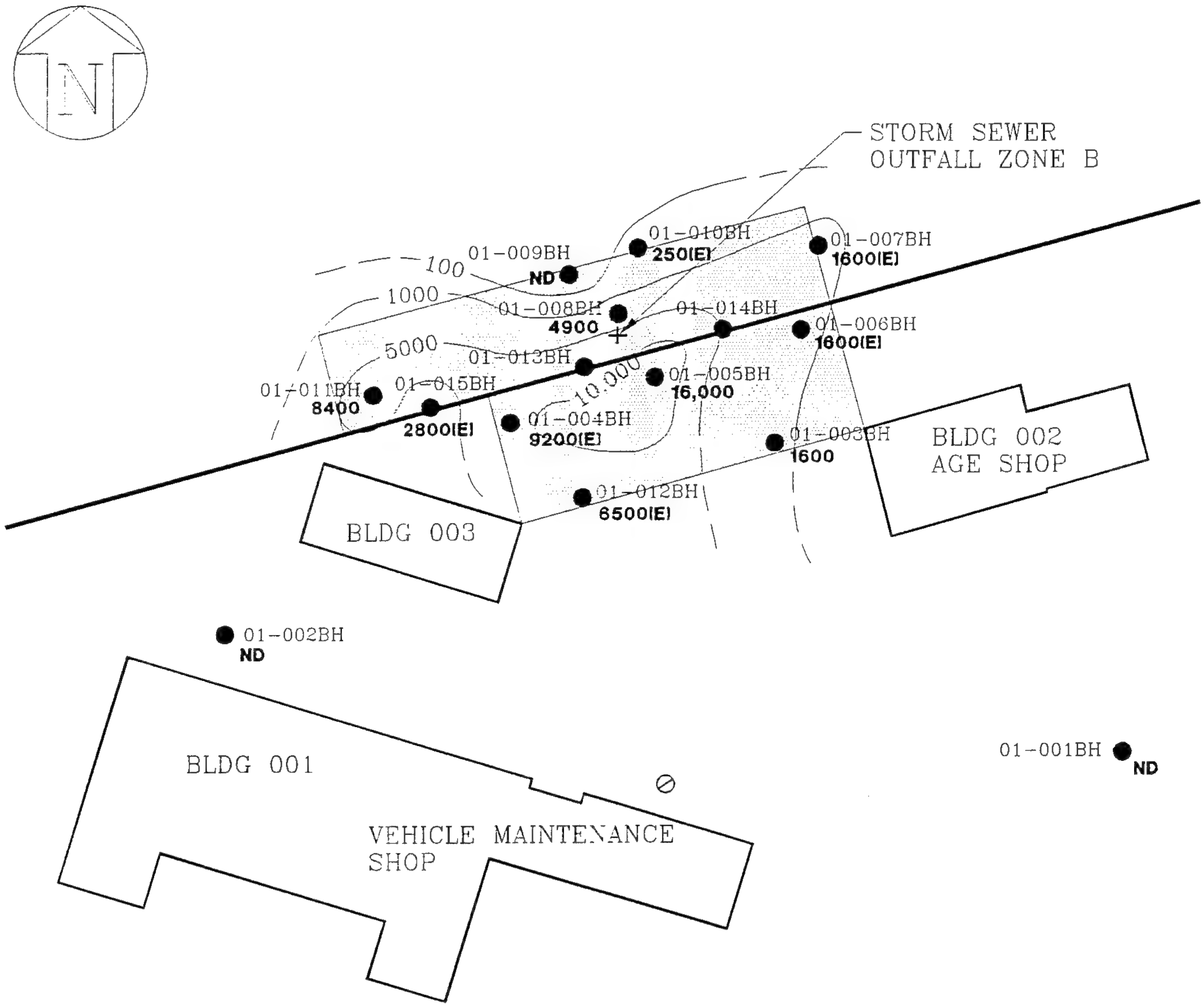
## Table 5.6
## Semivolatile Organic Compounds Detected in Soil Samples*
## 101st ACS, Worcester ANGS, Worcester, Massachusetts

| Semivolatile Organic Compounds | 01-003BH 0.5 - 2.0 (Ft BLS) | 01-004BH 0.5 - 2.0 (Ft BLS) | 01-004BH 5.0 - 5.9 (Ft BLS) | 01-005BH 6.0 - 7.5 (Ft BLS) | 01-006BH 4.0 - 5.5 (Ft BLS) | 01-006BH 7.0 - 7.75 (Ft BLS) | 01-007BH 0.0 - 1.0 (Ft BLS) | 01-007BH 1.0 - 2.0 (Ft BLS) | 01-008BH 0.0 - 1.0 (Ft BLS) | 01-010BH 0.0 - 1.0 (Ft BLS) |
|---|---|---|---|---|---|---|---|---|---|---|
| Acenaphthylene | 170J | 7,400U | 8,400U | 4,100U | 1,900U | 2,300U | 7,500U | 7,500U | 3,800U | 580U |
| Phenanthrene | **520** | 2,100J | 7,000J | **11,000** | 1,800J | 2,300U | 1,500J | 7,500U | **4,200** | 160J |
| Anthracene | 170J | 7,400U | 1,300J | 2,300J | 370J | 2,300U | 7,500U | 7,500U | 570J | 580U |
| Fluoranthene | **1,200** | 2,600J | 8,200J | **15,000** | 1,800J | 280J | 1,500J | 1,100J | 2,500J | 250J |
| Pyrene | **1,600** | 3,200J | 9,200J | **16,000** | 1,600J | 2,300U | 1,600J | 1,400J | **4,900** | 250J |
| Benzo(a)anthracene | **920** | 1,300J | 3,600J | **6,600** | 740J | 2,300U | 7,500U | 7,500U | 1,300J | 580U |
| Chrysene | **960** | 1,400J | 3,900J | **6,300** | 770J | 2,300U | 7,500U | 7,500U | 1,800J | 140J |
| Benzo(b)fluoranthene | **1,100** | 7,400U | 3,200J | **5,200** | 640J | 2,300U | 7,500U | 7,500U | 1,500J | 160J |
| Benzo(k)fluoranthene | **730** | 7,400U | 2,900J | **5,300** | 550J | 2,300U | 7,500U | 7,500U | 1,300J | 580U |
| Benzo(a)pyrene | **1,200** | 1,300J | 3,400J | **5,900** | 660J | 2,300U | 7,500U | 7,500U | 1,700J | 110J |
| Indeno(1,2,3-cd)pyrene | **1,000** | 7,400U | 8,400U | 3,500J | 1,900U | 2,300U | 7,500U | 7,500U | 1,600J | 580U |
| Dibenzo(a,h)anthracene | 220J | 7,400U | 8,400U | 4,100U | 1,900U | 2,300U | 7,500U | 7,500U | 3,800U | 580U |
| Benzo(g,h,i)perylene | **970** | 7,400U | 1,800J | 3,100J | 320J | 2,300U | 7,500U | 7,500U | 1,600J | 120J |
| Naphthalene | 350U | 7,400U | 8,400U | 4,100U | 1,900U | 2,300U | 7,500U | 7,500U | 3,300J | 580U |
| Fluorene | 350U | 7,400U | 8,400U | 970J | 1,900U | 2,300U | 7,500U | 7,500U | 1,000J | 580U |
| Carbazole | 350U | 7,400U | 8,400U | 880J | 1,900U | 2,300U | 7,500U | 7,500U | 3,800U | 580U |
| Benzoic Acid | 870U | 19,000U | 21,000U | 10,000U | 1,900U | 5,600U | 19,000U | 19,000U | 9,600U | **1,400** |
| Diethylphthalate | 350U | 7,400U | 8,400U | 4,100U | 1,900U | 2,300U | 7,500U | 7,500U | 3,800U | 580U |
| bis(2-Ethylhexyl)phthalate | 350U | 7,400U | 8,400U | 1,700J | 1,900U | 2,300U | 7,500U | 7,500U | **11,000** | 580U |
| Isophorone | 350U | 7,400U | 8,400U | 4,100U | 1,900U | 2,300U | 7,500U | 7,500U | 2,900J | 580U |
| 2-Methylnaphthalene | 350U | 7,400U | 8,400U | 4,100U | 1,900U | 2,300U | 7,500U | 7,500U | **7,700** | 580U |

## Table 5.6 (Concluded)
## Semivolatile Organic Compounds Detected in Soil Samples*
## 101st ACS, Worcester ANGS, Worcester, Massachusetts

| Semivolatile Organic Compounds | 01-011BH 0.0 - 1.0 (Ft BLS) | 01-011BH Duplicate | 01-012BH 0.5 - 2.0 (Ft BLS) | 01-012BH 5.5 - 7.0 (Ft BLS) | 01-013BH 0.5 - 1.5 (Ft BLS) | 01-015BH 0.0 - 1.0 (Ft BLS) | 01-015BH Duplicate | MBLK 11/19/93 | MBLK 11/24/93 |
|---|---|---|---|---|---|---|---|---|---|
| Acenaphthylene | 8,500U | 8,300U | 94J | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Phenanthrene | 7,900J | 5,300J | **1,000** | 5,400J | 1,900U | 1,900J | 1,500J | 330U | 330U |
| Anthracene | 1,700J | 1,400J | 240J | 1,300J | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Fluoranthene | 7,100J | 6,800J | **1,200** | 4,800J | 280J | 2,700J | 2,300J | 330U | 330U |
| Pyrene | **8,600** | **8,400** | **1,200** | 6,500J | 310J | 3,200J | 2,800J | 330U | 330U |
| Benzo(a)anthracene | 3,400J | 3,400J | **660** | 2,700J | 1,900U | 1,300J | 7,500U | 330U | 330U |
| Chrysene | 3,400J | 3,600J | **650** | 2,800J | 1,900U | 1,600J | 1,500J | 330U | 330U |
| Benzo(b)fluoranthene | 2,600J | 3,300J | **560** | 2,200J | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Benzo(k)fluoranthene | 2,200J | 2,300J | **510** | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Benzo(a)pyrene | 2,900J | 3,200J | **680** | 2,400J | 280J | 1,500J | 1,400J | 330U | 330U |
| Indeno(1,2,3-cd)pyrene | 8,500U | 8,300U | **660** | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Dibenzo(a,h)anthracene | 8,500U | 8,300U | 200J | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Benzo(g,h,i)perylene | 1,500J | 1,800J | **590** | 1,400J | 1,900U | 1,500J | 1,400J | 330U | 330U |
| Naphthalene | 8,500U | 8,300U | 88J | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Fluorene | 8,500U | 8,300U | 80J | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Carbazole | 8,500U | 8,300U | 82J | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |
| Benzoic Acid | 21,000U | 21,000U | 890U | 18,000U | 4,800U | 19,000U | 19,000U | 830U | 830U |
| Diethylphthalate | 8,500U | 8,300U | 360U | 7,400U | 660J | 7,700U | 7,500U | 50J | 330U |
| bis(2-Ethylhexyl)phthalate | 8,500U | 8,300U | 360U | 7,400U | 1,900U | 7,700U | 7,500U | 330U | **360** |
| Isophorone | 8,500U | 8,300U | 360U | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |
| 2-Methylnaphthalene | 8,500U | 8,300U | 360U | 7,400U | 1,900U | 7,700U | 7,500U | 330U | 330U |

*All analytes reported as $\mu g/kg$.
BH – Borehole.
BLS – Below Land Surface.
MBLK – Laboratory Method Blank.
U – Compound analyzed for but not detected. Number indicates the DL.
J – Compound detected below the DL. Number indicates the concentration detected.
**Bold** – Indicates compound detected and concentrations in excess of the DL.




NOTE:

01-013BH AND 01-014BH PYRENE LEVELS WERE NOT USED SINCE THEY MAY NOT REPRESENT PYRENE CONCENTRATION AT DEPTH.

(E) – INDICATES AN ESTIMATE VALUE SINCE IT WAS BELOW THE DETECTION LIMIT FOR THAT SAMPLE.

## LEGEND

| | |
|---|---|
| | IRP SITE NO.1 |
| | STATION BOUNDARY (PERIMETER FENCE) |
| ⊘ | OIL/WATER SEPARATOR |
| 1600 | SOIL BORING LOCATION WITH PYRENE CONCENTRATION (ug/kg) |
| 100 | PYRENE CONTOUR LINE |
| ND | NON DETECT |

0 40

SCALE IN FEET

SOURCE: TAUPER SURVEY, 1993.

FIGURE 5.6

WORCESTER\CONTOURS

HIGHEST PYRENE (SVOC) CONTAMINATION PER BOREHOLE AT IRP SITE NO.1

101st ACS and 212th EIS

Worcester Air National Guard Station

Worcester, Massachusetts

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Boreholes 01-003BH (0.5 - 2.0 feet BLS) and 01-012BH (0.5 - 2.0 feet BLS) also indicated concentrations of indeno(1,2,3-cd)pyrene at 1,000 g/kg and 660 $\mu$g/kg, respectively, and benzo(g,h,i)perylene at 970 $\mu$g/kg and 590 $\mu$g/kg, respectively.

The maximum levels of other SVOCs detected were bis(2-ethylhexyl)phthalate (11,000 $\mu$g/kg) and 2-methylnaphthalene (7,700 $\mu$g/kg) at 01-008BH (0.0 - 1.0 feet BLS), and benzoic acid (1,400 $\mu$g/kg) at 01-010BH (0.0 - 1.0 feet BLS).

#### 5.2.2.3.3 PCBs Contamination

PCBs were not detected in soil samples analyzed for those parameters in any of the 21 samples submitted.

#### 5.2.2.3.4 Metals Contamination

Priority pollutant metals were analyzed for in all soil samples collected at IRP Site No. 1. Ten of the 13 target metals were detected in all samples, including background samples. Antimony, silver, and selenium were not reported above DLs in any samples. Procedures for selection of background soil sampling locations and data collection are outlined in Subsection 5.1.1. Background analytical results were used to evaluate concentrations detected in samples at the site. Table 5.7 lists the priority pollutant metals detected in soil samples and includes the background sampling locations (01-001BH and 01-002BH).

The highest concentration of arsenic was detected in the background borehole 01-002BH (0.5 - 2.0 feet BLS) at 67 mg/kg. Arsenic concentrations ranged from 67 mg/kg to 9.3 mg/kg at 01-009BH (0.0 - 1.0 feet BLS). Only three samples, 01-010BH (0.0 - 1.0 feet BLS) at 49 mg/kg, 01-015BH (duplicate) at 39 mg/kg, and 01-003BH (7.0 - 7.75 feet BLS) at 38 mg/kg had concentrations greater than the second background sample 01-001BH (0.5 - 2.0 feet BLS) at 36 mg/kg.

Beryllium concentrations ranged from 1.2 mg/kg at 01-003BH (7.0 - 7.75 feet BLS) to 0.1 mg/kg at 01-014BH (0.5 - 1.5 feet BLS). Sixteen of the 22 Site-Investigative samples exceeded concentrations detected in the two background samples (0.3 mg/kg and 0.2 mg/kg in 01-002BH and 01-001BH, respectively).

## Table 5.7
## Metals Detected in Soil Samples*
## 101st ACS, Worcester ANGS, Worcester, Massachusetts

| Metals | 01-001BH 0.5 - 2.0 (Ft BLS) | 01-002BH 0.5 - 2.0 (Ft BLS) | 01-003BH 0.5 - 2.0 (Ft BLS) | 01-003BH 7.0 - 7.75 (Ft BLS) | 01-004BH 0.5 - 2.0 (Ft BLS) | 01-004BH 5.0 - 5.9 (Ft BLS) | 01-005BH 0.5 - 2.0 (Ft BLS) | 01-005BH 6.0 - 7.5 (Ft BLS) | 01-006BH 4.0 - 5.5 (Ft BLS) | 01-006BH 7.0 - 7.75 (Ft BLS) |
|---|---|---|---|---|---|---|---|---|---|---|
| Antimony | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| Arsenic | 36.0 | 67.0 | 32.0 | 38.0 | 35.0 | 25.0 | 16.0 | 20.0 | 18.0 | 34.0 |
| Beryllium | 0.2 | 0.3 | 0.7 | 1.2 | 0.5 | 0.6 | 0.2 | 0.7 | 0.5 | 1.0 |
| Cadmium | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | 0.6 | <0.4 | <0.5 | <0.4 | 0.5 |
| Chromium | 18.0 | 19.3 | 20.9 | 44.2 | 26.2 | 23.9 | 15.5 | 41.7 | 24.6 | 18.7 |
| Copper | 36.0 | 45.4 | 26.2 | 22.9 | 47.6 | 94.3 | 48.0 | 155.0 | 31.5 | 24.3 |
| Lead | 20.0 | 9.1 | 60.0 | 10.0 | 130.0 | 530.0 | 5.2 | 660.0 | 110.0 | 40.0 |
| Mercury | <0.1 | <0.1 | <0.1 | <0.1 | 0.3 | 1.2 | <0.1 | 0.3 | <0.1 | <0.1 |
| Nickel | 21.0 | 29.0 | 17.0 | 31.0 | 23.0 | 19.0 | 13.0 | 22.0 | 21.0 | 10.0 |
| Selenium | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.8 | <0.5 | <0.6 | <0.5 | <0.7 |
| Silver | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.5 | <0.4 | <0.5 | <0.4 | <0.5 |
| Thallium | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.1 | 0.5 | 0.2 | 0.4 |
| Zinc | 53.2 | 50.7 | 51.9 | 52.9 | 130.0 | 213.0 | 38.0 | 225.0 | 96.9 | 65.5 |

| Metals | 01-007BH 0.0 - 1.0 (Ft BLS) | 01-007BH Duplicate | 01-007BH 1.0 - 2.0 (Ft BLS) | 01-008BH 0.0 - 1.0 (Ft BLS) | 01-009BH 0.0 - 1.0 (Ft BLS) | 01-010BH 0.0 - 1.0 (Ft BLS) | 01-011BH 0.0 - 1.0 (Ft BLS) | 01-011BH Duplicate | 01-012BH 0.5 - 2.0 (Ft BLS) | 01-012BH 5.5 - 7.0 (Ft BLS) |
|---|---|---|---|---|---|---|---|---|---|---|
| Antimony | <10.0 | <10.0 | <10.0 | <20.0 | <10.0 | <20.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| Arsenic | 20.0 | 12.0 | 25.0 | 30.0 | 9.3 | 49.0 | 29.0 | 26.0 | 17.0 | 21.0 |
| Beryllium | 0.7 | 0.3 | 0.8 | 1.0 | 0.3 | 0.5 | 0.6 | 0.6 | 0.3 | 0.3 |
| Cadmium | 1.0 | 0.7 | 0.4 | 5.5 | 2.1 | 1.0 | <0.5 | 2.0 | <0.4 | <0.4 |
| Chromium | 35.2 | 17.2 | 35.0 | 549.0 | 1,800.0 | 184.0 | 29.7 | 22.0 | 32.8 | 26.6 |
| Copper | 26.0 | 11.9 | 25.4 | 87.5 | 177.0 | 46.1 | 53.1 | 43.5 | 23.3 | 22.3 |
| Lead | 140.0 | 40.0 | 60.0 | 660.0 | 240.0 | 200.0 | 140.0 | 150.0 | 20.0 | 30.0 |
| Mercury | <0.1 | <0.1 | <0.1 | <0.2 | 0.1 | <0.2 | 0.3 | 0.2 | <0.1 | <0.1 |
| Nickel | 22.0 | 11.0 | 27.0 | 20.0 | 2.0 | 10.0 | 23.0 | 17.0 | 21.0 | 20.0 |
| Selenium | <0.5 | <0.5 | <0.6 | <1.0 | <0.6 | 1.0 | <0.6 | <0.6 | <0.5 | <0.5 |
| Silver | <0.4 | <0.4 | <0.4 | <0.8 | <0.5 | <0.7 | <0.5 | <0.5 | <0.4 | <0.4 |
| Thallium | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 1.0 | 0.5 | 0.3 | 0.2 | 0.2 |
| Zinc | 81.1 | 49.2 | 68.5 | 414.0 | 108.0 | 86.9 | 123.0 | 135.0 | 46.9 | 44.7 |

**Table 5.7 (Concluded)
Metals Detected in Soil Samples*
101st ACS, Worcester ANGS, Worcester, Massachusetts**

| Metals | 01-013BH 0.5 - 1.5 (Ft BLS) | 01-014BH 0.5 - 1.5 (Ft BLS) | 01-015BH 0.0 - 1.0 (Ft BLS) | 01-015BH Duplicate |
|---|---|---|---|---|
| Antimony | <10.0 | <10.0 | <10.0 | <10.0 |
| Arsenic | 24.0 | 9.8 | 24.0 | 39.0 |
| Beryllium | 0.7 | 0.1 | 0.5 | 0.5 |
| Cadmium | 5.7 | <0.4 | 1.2 | 1.2 |
| Chromium | 29.6 | 16.1 | 22.9 | 24.8 |
| Copper | 84.2 | 14.9 | 35.5 | 39.1 |
| Lead | 210.0 | 5.3 | 80.0 | 90.0 |
| Mercury | <0.1 | <0.1 | 0.4 | <0.1 |
| Nickel | 26.0 | 12.0 | 20.0 | 17.0 |
| Selenium | <0.5 | <0.5 | <0.5 | <0.6 |
| Silver | <0.4 | <0.4 | <0.4 | <0.4 |
| Thallium | 0.4 | <0.1 | 0.3 | 0.2 |
| Zinc | 185.0 | 66.4 | 133.0 | 121.0 |

*All analytes reported as mg/kg.
BH – Borehole.
BLS – Below Land Surface.

Cadmium concentrations ranged from 5.7 mg/kg at 01-013BH (0.5 - 1.5 feet BLS) to below DLs in 12 samples, including both background samples. Cadmium was detected below 5.7 mg/kg in 12 investigative samples.

Chromium concentrations ranged from 1,800 mg/kg at 01-009BH (0.0 - 1.0 feet BLS) to 15.5 mg/kg at 01-005BH (0.5 - 2.0 feet BLS). Eighteen of the 22 Site-Investigative samples exceeded concentrations detected in the two background samples (19.3 mg/kg and 18.0 mg/kg in 01-002BH and 01-001BH, respectively). Two samples, 01-008BH (0.0 - 1.0 feet BLS) at 549 mg/kg and 01-010BH (0.0 - 1.0 feet BLS) at 184 mg/kg, exceeded 100 mg/kg concentrations.

Copper concentrations ranged from 177 mg/kg at 01-009BH (0.0 - 1.0 feet BLS) to 11.9 mg/kg at 01-007BH (duplicate). Nine of the 22 Site-Investigative samples exceeded concentrations detected in the two background samples (45.4 mg/kg and 36 mg/kg in 01-002BH and 01-001BH, respectively). Two samples, 01-009BH (0.0 - 1.0 feet BLS) at 177 mg/kg and 01-005BH (6.0 -7.5 feet BLS) at 155 mg/kg, exceeded 100 mg/kg concentrations.

Lead concentrations ranged from 660 mg/kg at 01-008BH (0.0 - 1.0 feet BLS) and 01-005BH (0.5 - 2.0 feet BLS) to 5.2 mg/kg at 01-005BH (6.0 - 7.5 feet BLS). Eighteen of the 22 Site-Investigative samples exceeded concentrations detected in the two background samples (20

mg/kg and 9.1 mg/kg in 01-001BH and 01-002BH, respectively). Ten samples, 01-008BH (0.0 - 1.0 feet BLS) at 660 mg/kg, 01-005BH (6.0 - 7.5 feet BLS) at 660 mg/kg, 01-004BH (5.0 - 5.9 feet BLS) at 530 mg/kg, 01-009BH (0.0 - 1.0 feet BLS) at 240 mg/kg, 01-013BH (0.5 - 1.5 feet BLS) at 210 mg/kg, 01-011BH (duplicate) at 150 mg/kg, 01-007BH (0.0 - 1.0 feet BLS) and 01-011BH (0.0 - 1.0 feet BLS) at 140 mg/kg, 01-004BH (0.5 - 2.0 feet BLS) at 130 mg/kg, and 01-006BH (4.0 - 5.5 feet BLS) at 110 mg/kg, exceeded 100 mg/kg concentrations. Lead reported per borehole is shown in Figure 5.7.

Mercury concentrations ranged from 1.2 mg/kg at 01-004BH (5.0 - 5.9 feet BLS) to below DLs in 17 samples, including both background samples. Mercury was detected below 1.2 mg/kg in seven investigative samples.

Nickel concentrations ranged from 31 mg/kg at 01-003BH (7.0 - 7.75 feet BLS) to 2.0 mg/kg at 01-009BH (0.0 - 1.0 feet BLS). Only sample 01-003BH (7.0 - 7.75 feet BLS) exceeded concentrations detected in the highest background sample (29 mg/kg at 01-002BH).

Thallium concentrations ranged from 1.0 mg/kg at 01-010BH (0.0 - 1.0 feet BLS) to below DLs at 01-014BH (0.5 - 1.5 feet BLS). Nine Site-Investigative samples, 01-010BH (0.0 - 1.0 feet BLS) at 1.0 mg/kg, 01-005BH (6.0 - 7.5 feet BLS) and 01-011BH (0.0 - 1.0 feet BLS) at 0.5 mg/kg, 01-006BH (7.0 - 7.75 feet BLS) and 01-013BH (0.5 - 1.5 feet BLS) at 0.4 mg/kg, and Figure 5.7 01-003BH (7.0 - 7.75 feet BLS), 01-004BH (0.5 - 2.0 feet BLS), 01-011BH (duplicate), and 01-015BH (0.0 - 1.0 feet BLS) at 0.3 mg/kg exceeded concentrations detected in the background samples (0.2 mg/kg at 01-001BH and 01-002BH).

Zinc concentrations ranged from 414 mg/kg at 01-008BH (0.0 - 1.0 feet BLS) to 38 mg/kg at 01-005BH (0.5 - 2.0 feet BLS). Sixteen of the 22 Site-Investigative samples exceeded concentrations detected in the two background samples (53.2 mg/kg and 50.7 mg/kg in 01-001BH and 01-002BH, respectively). Ten samples, 01-008BH (0.0 - 1.0 feet BLS) at 414 mg/kg, 01-005BH (6.0 - 7.5 feet BLS) at 225 mg/kg, 01-004BH (5.0 - 5.9 feet BLS) at 213 mg/kg, 01-013BH (0.5 - 1.5 feet BLS) at 185 mg/kg, 01-011BH (duplicate) at 135 mg/kg, 01-015BH (0.0 - 1.0 feet BLS) at 133 mg/kg, 01-004BH (0.5 - 2.0 feet BLS) at 130 mg/kg, 01-011BH (0.0 - 1.0 feet BLS) at 123 mg/kg, 01-015 (duplicate) at 121 mg/kg, and 01-009BH (0.0 - 1.0 feet BLS) at 108 mg/kg, exceeded 100 mg/kg concentrations.

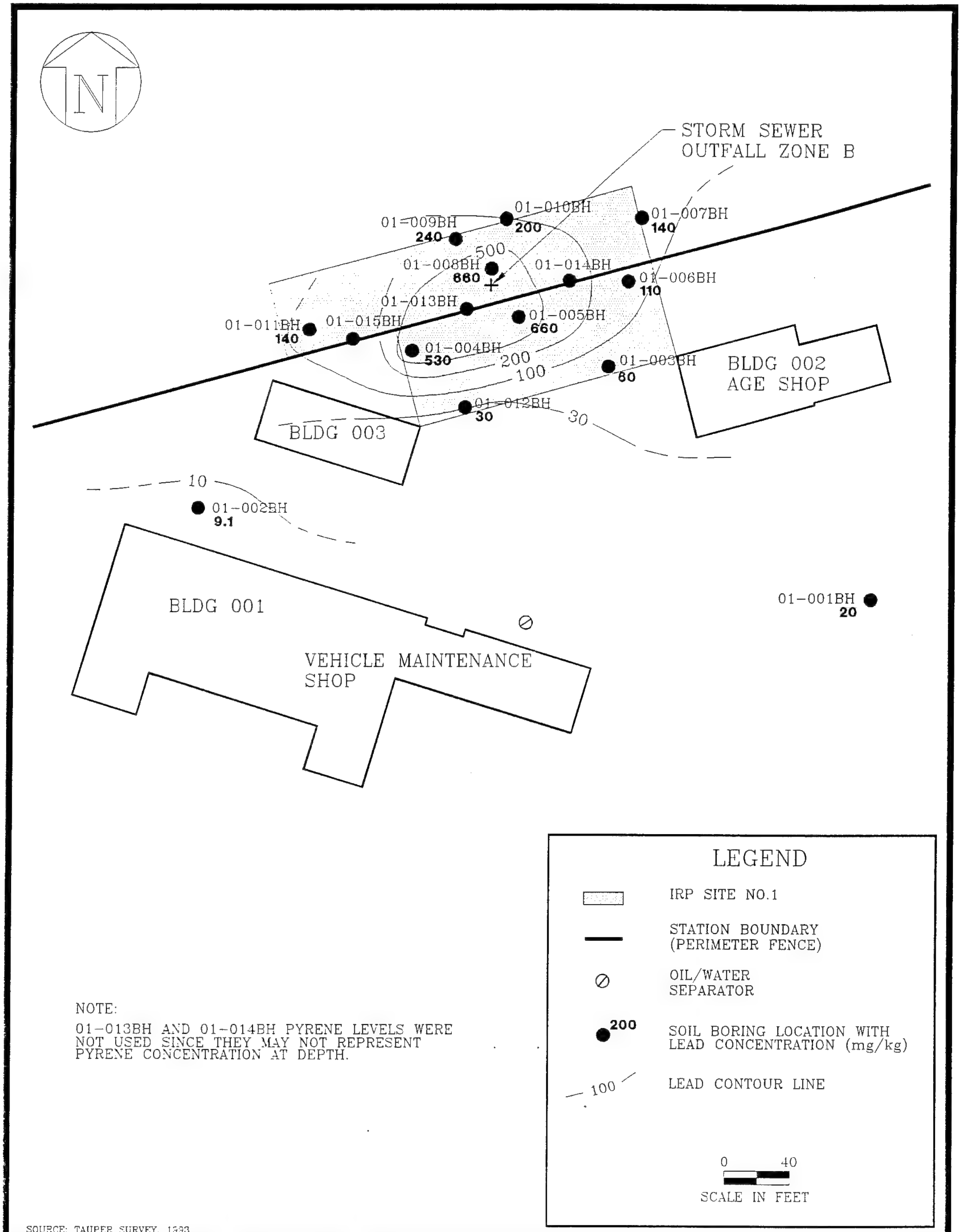


FIGURE 5.7

WORCESTER CONTOURS

HIGHEST LEAD CONTAMINATION PER BOREHOLE AT IRP SITE NO.1
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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#### 5.2.2.3.5 TPH Contamination

TPH was detected at concentrations ranging from 130,000 mg/kg to 75 mg/kg in 11 of the 21 investigative samples and three duplicate samples as summarized in Table 5.8. Borehole 01-008BH (0.0 - 1.0 feet BLS) had the highest concentration of TPH at 130,000 mg/kg; borehole 01-012BH (5.5 - 7.0 feet BLS) had TPH detected at 17,400 mg/kg. Six additional borehole locations indicated TPH contamination greater than 100 mg/kg; 01-005BH (6.0 - 7.5 feet BLS) at 790 mg/kg, 01-007BH (0.0 - 1.0 feet BLS, duplicate) at 410 mg/kg, 01-007BH (1.0 - 2.0 feet BLS) at 260 mg/kg, 01-015BH (0.0 - 1.0 feet BLS) at 210 mg/kg, 01-007BH (0.0 - 1.0 feet BLS) at 160 mg/kg, and 01-004BH (5.0 - 5.9 feet BLS) at 150 mg/kg. Three borehole locations detected TPH contamination at less than 100 mg/kg but greater than the DLs; 01-007BH (0.5 - 2.0 feet BLS) at 92 mg/kg, 01-013BH (0.5 - 1.5 feet BLS) at 87 mg/kg, and 01-006BH (4.0 - 5.5 feet BLS) at 75 mg/kg. TPH contamination per borehole is shown in Figure 5.8.

**Table 5.8**
**TPH Detected in Soil Samples**
**101st ACS, Worcester ANGS, Worcester, Massachusetts**

| Borehole | Sample Depth (feet BLS) | TPH (mg/kg) |
|---|---|---|
| 01-002BH | 0.5 - 2.0 | 92 |
| 01-004BH | 5.0 - 5.9 | 150 |
| 01-005BH | 6.0 - 7.5 | 790 |
| 01-006BH | 4.0 - 5.5 | 75 |
| 01-007BH | 0.0 - 1.0 | 160 |
| 01-007BH | Duplicate | 410 |
| 01-007BH | 1.0 - 2.0 | 260 |
| 01-008BH | 0.0 - 1.0 | 130,000 |
| 01-012BH | 5.5 - 7.0 | 17,400 |
| 01-013BH | 0.5 - 1.5 | 87 |
| 01-015BH | 0.0 - 1.0 | 210 |

BLS – Below land surface.
TPH – Total petroleum Hydrocarbons.
mg/kg – Milligrams per kilogram.

### 5.2.3 Conclusions

Soil samples were collected from IRP Site No. 1 and submitted for laboratory analysis to confirm the presence or absence of contamination and to provide data needed to reach a decision for the site. Past activities at the site indicated that suspected contamination consists of waste oil, organic solvents, and fuels. Therefore, samples were submitted for analysis of VOCs.

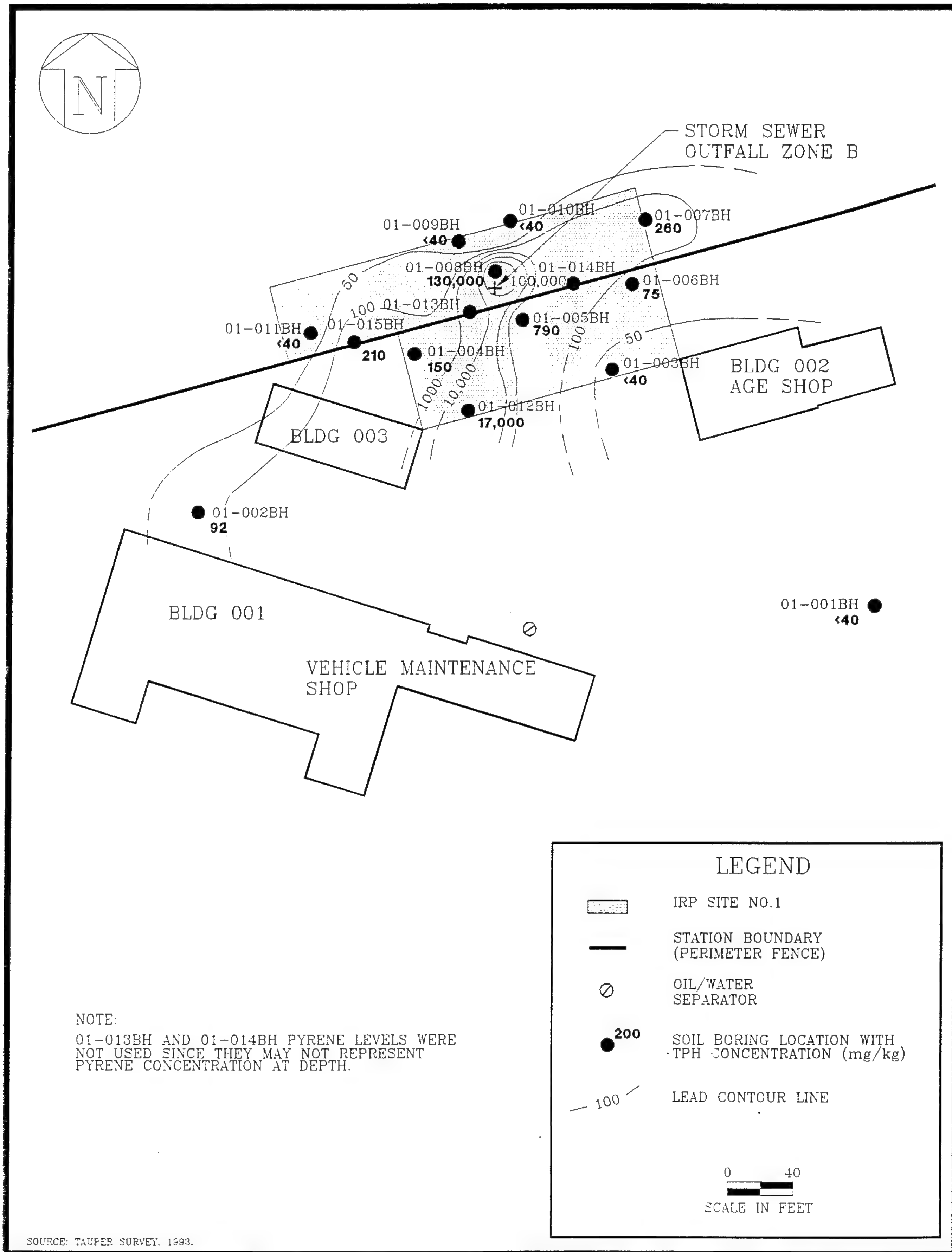


FIGURE 5.8

WORCESTER\CONTOURS

HIGHEST TPH
CONTAMINATION PER BOREHOLE
AT IRP SITE NO.1
101st ACS and 212th EIS
Worcester Air National Guard Station
Worcester, Massachusetts

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SVOCs, and TPH. To satisfy MADEP requirements, samples were also analyzed for PCBs and priority pollutant metals.

Only those parameters, reported at greater than the sample quantification limit, exceeding background and/or ARARs provided by the State of Massachusetts and the MADEP, are addressed in this subsection. Applicable MADEP ARARs are shown in Appendix G.

None of the report laboratory results for the 21 soil samples submitted for VOC analysis exceeded MADEP Reportable Concentrations, as specified in the Massachusetts Contingency Plan.

Five of the 21 soil samples submitted for SVOC analysis exceeded Reportable Concentrations, as summarized in Table 5.9. Benzo(a)pyrene was detected at boreholes 01-003BH and 01-005BH (at concentrations of 1,200 $\mu$g/kg and 5,900 $\mu$g/kg, respectively) at depths of 0.5 - 2.0 feet BLS and 6.0 - 7.5 feet BLS, respectively. Benzo(b)fluoranthene was detected at boreholes 01-003BH and 01-005BH (at concentrations of 730 $\mu$g/kg and 5,300 $\mu$g/kg, respectively) at depths of 0.5 - 2.0 feet BLS and 6.0 - 7.5 feet BLS, respectively. 2-methylnaphthalene was detected at borehole 01-008BH (at a concentration of 7,700 $\mu$g/g) at a depth of 0.0 - 1.0 foot BLS.

PCBs were not detected in any of the 21 soil samples submitted for analysis.

Twenty-one soil samples were submitted for priority pollutant metals analysis. Thirteen samples contained at least one target metal at concentrations exceeding Reportable Concentrations as summarized in Table 5.9. Only arsenic, beryllium, and lead were detected at concentrations exceeding Reportable Concentrations of 30 mg/kg, 0.8 mg/kg, and 600 mg/kg, respectively. A general comparison of concentrations of arsenic, beryllium, and lead found at the Worcester ANGS with those normally found in the native soils of central Massachusetts revealed high arsenic and lead concentrations (as compared with common background levels of 6.5 ppm and 15.0 ppm, respectively). Beryllium concentrations were within or lower than the range commonly found in the area (1.0 to 1.5 ppm). Information on background metal concentrations commonly found in the area was obtained from a United States Geological Survey (USGS) publication, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States (Shacklette and Boerngen. 1984).

Arsenic was detected at boreholes 01-001BH through 01-004BH, 01-006BH, 01-009BH, and 01-015BH. In borehole 01-001BH, arsenic was detected at a concentration of 36 mg/kg at 0.5 -

**Table 5.9**
**Summary of Analytes Exceeding Reportable Concentrations in Soil Samples**
**101st ACS, Worcester ANGS, Worcester, Massachusetts**

| Analyte | Borehole | Depth (Ft BLS) | Concentration | Massachusetts State Reportable Concentrations[a] |
|---|---|---|---|---|
| **SVOCs** | | | | |
| Benzo(a)pyrene | 01-003BH | 0.5 - 2.0 | 1,200 µg/kg | 700 µg/kg |
| | 01-005BH | 6.0 - 7.5 | 5,900 µg/kg | 700 µg/kg |
| Benzo(b)fluoranthene | 01-003BH | 0.5 - 2.0 | 1,100 µg/kg | 1,000 µg/kg |
| | 01-005BH | 6.0 - 7.5 | 5,200 µg/kg | 1,000 µg/kg |
| 2-methylnaphthalene | 01-008BH | 0.0 - 1.0 | 7,700 µg/kg | 700 µg/kg |
| **Metals** | | | | |
| Arsenic | 01-001BH | 0.5 - 2.0 | 36 mg/kg | 30 mg/kg |
| | 01-002BH | 0.5 - 2.0 | 67 mg/kg | 30 mg/kg |
| | 01-003BH | 0.5 - 2.0 | 32 mg/kg | 30 mg/kg |
| | | 7.0 - 7.5 | 38 mg/kg | 30 mg/kg |
| | 01-004BH | 0.5 - 2.0 | 35 mg/kg | 30 mg/kg |
| | 01-006BH | 7.0 - 7.5 | 34 mg/kg | 30 mg/kg |
| | 01-009BH | 0.0 - 1.0 | 49 mg/kg | 30 mg/kg |
| | 01-015BH | Dup | 39 mg/kg | 30 mg/kg |
| Beryllium | 01-003BH | 7.0 - 7.5 | 1.2 mg/kg | 0.8 mg/kg |
| | 01-006BH | 7.0 - 7.5 | 1.0 mg/kg | 0.8 mg/kg |
| | 01-008BH | 0.0 - 1.0 | 1.0 mg/kg | 0.8 mg/kg |
| Lead | 01-005BH | 6.0 - 7.5 | 660 mg/kg | 600 mg/kg |
| | 01-008BH | 0.0 - 1.0 | 660 mg/kg | 600 mg/kg |
| **TPH** | 01-008BH | 0.0 - 1.0 | 130,000 mg/kg | 2,500 mg/kg |
| | 01-012BH | 5.5 - 7.0 | 17,400 mg/kg | 2,500 mg/kg |

[a]Source: The Massachusetts Contingency Plan 310 CMR 40.0975.
BLS — Below Land Surface.
SVOCs — Semivolatile Organic Compounds.
BH — Borehole.
µg/kg — micrograms per kilogram.
mg/kg — milligrams per kilogram.
Dup — Duplicate.

2.0 feet BLS. In borehole 01-002BH, arsenic was detected at a concentration of 67 mg/kg at 0.5 - 2.0 feet BLS. In borehole 01-003BH, arsenic was detected at concentrations of 32 mg/kg and 38 mg/kg at 0.5 - 2.0 and 7.0 - 7.5 feet BLS, respectively. In borehole 01-004BH, arsenic was detected at a concentration of 35 mg/kg at 0.5 - 2.0 feet BLS. In borehole 01-006BH, arsenic was detected at a concentration of 34 mg/kg at 7.0 - 7.5 feet BLS. In borehole 01-009BH, arsenic was detected at a concentration of 49 mg/kg at 0.0 - 1.0 foot BLS. In borehole 01-015BH, arsenic was detected at a concentration of 39 mg/kg in its duplicate sample. Beryllium was detected at boreholes 01-003BH, 01-006BH, and 01-008BH. In borehole

01-003BH, beryllium was detected at a concentration of 1.2 mg/kg at 7.0 - 7.5 feet BLS. In borehole 01-006BH, beryllium was detected at a concentration of 1.0 mg/kg at 7.0 - 7.5 feet BLS. In borehole 01-008BH, beryllium was detected at a concentration of 1.0 mg/kg at 0.0 - 1.0 foot BLS.

Lead was detected at boreholes 01-005BH and 01-008BH at a concentration of 660 mg/kg for both boreholes, and at depths of 6.0 - 7.5 feet BLS and 0.0 - 1.0 foot BLS, respectively.

Two of the 21 soil samples submitted for TPH analysis exceeded Reportable Concentrations, as shown in Table 5.9. TPH was detected at borings 01-008BH and 01-012BH (at concentrations of 130,000 mg/kg and 17,400 mg/kg, respectively) at depths of 0.0 - 1.0 foot BLS and 5.5 - 7.0 feet BLS, respectively. The Reportable Concentration for TPH is 2,500 mg/kg.

In accordance with the scope of work, no groundwater investigation was conducted as part of the SI at Worcester ANGS.

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# SECTION 6.0 CONCLUSIONS AND RECOMMENDATIONS

## 6.1 SUMMARY

An SI was conducted at the Old Embankment/Vicinity of the Old Waste Holding Area (also referred to as the site) located at the 212th EIS, MASS ANG, Worcester, Massachusetts. A PA of the Station conducted by Science & Technology in May of 1990 determined that the site was subjected to four different waste handling or disposal activities. Consequently, the site was identified and recommended for further investigation under the IRP.

The ANGRC/CEVR authorized OpTech to prepare an SI Work Plan and conduct the SI at the Old Embankment/Vicinity of the Old Waste Holding Area. This investigation was conducted as outlined in the SI Work Plan submitted to the ANGRC/CEVR and MADEP in July 1993. The field investigation at the 212th EIS commenced on 15 November 1993 and was completed on 19 November 1993.

The field investigation at the 212th EIS was accomplished by completing the following tasks:

- Locating underground lines and utilities;
- Drilling 13 soil borings to determine whether contamination exists at the site, and two soil borings to determine background soil conditions;
- Collecting 21 soil samples for analysis of VOCs, SVOCs, priority pollutant metals, TPH, and PCBs; and
- Surveying the location and elevation of all soil borings.

## 6.2 CONCLUSIONS

### 6.2.1 Soil Contamination

Contaminants in soil samples collected during the SI were detected at concentrations exceeding Reportable Concentrations established in the Massachusetts Contingency Plan (310 CMR 40.1600) and/or background levels, as described in Section 5.0. Additionally, two previously unidentified sources of contamination were identified: a leaking UST and a dry well previously identified as an OWS. During removal of USTs and the dry well, as discussed in

Subsection 2.2.3, contamination was detected and limited soil excavation was conducted. The areal extent of the contamination has not been defined.

SVOC contamination exceeding Reportable Concentrations was detected in three soil borings (01-003BH, 01-005BH, and 01-008BH) drilled at the Old Embankment/Vicinity of the Old Waste Holding Area.

Benzo(a)pyrene contamination was encountered in soil sampled from borings 01-003BH and 01-005BH, and was present at concentrations of 1,200 and 5,900 $\mu$g/kg at 0.5 - 2.0 feet and 6.0 - 7.5 feet BLS, respectively. Benzo(b)fluoranthene contamination was encountered in soil sampled from borings 01-003BH and 01-005BH, and was present at concentrations of 1,100 and 5,200 $\mu$g/kg at 0.5 - 2.0 feet and 6.0 - 7.5 feet BLS, respectively. 2-methylnaphthalene contamination was encountered in soil sampled from boring 01-008BH at a concentration of 7,700 $\mu$g/kg at 0.0 - 1.0 foot BLS.

Metals contamination (arsenic, beryllium and lead) exceeding Reportable Concentrations was detected in eight soil borings drilled at the site. Both arsenic and lead concentrations are considerably higher than those commonly found in the area, while beryllium levels are within or below the range commonly found in central Massachusetts (Shacklette and Boerngen, 1984). Arsenic contamination was encountered in soil sampled from borings 01-001BH through 01-004BH, 01-006BH, 01-009BH, and 01-015BH. Arsenic was detected at concentrations ranging from 32 to 49 mg/kg at depths ranging from 0.0 - 7.75 feet BLS. Beryllium contamination was encountered in soil sampled from borings 01-003BH and 01-006BH, and was present at concentrations of 1.2 and 1.0 mg/kg, respectively. Both samples were collected at a depth of 7.0 - 7.5 feet BLS. Lead contamination was encountered in soils sampled from borings 01-005BH and 01-008BH, and was present at a concentration of 660 mg/kg at both boreholes. Samples were collected at depths of 6.0 - 7.5 feet and 0.0 - 1.0 foot, respectively.

TPH contamination exceeding Reportable Concentrations was detected in soil sampled from borings 01-008BH and 01-012BH, and was present at concentrations of 130,000 and 17,400 mg/kg at 0.0 - 1.0 foot and 5.5 - 7.0 feet BLS, respectively.

The locations of background soil borings 01-001BH and 01-002BH have been determined to be not representative of background conditions, based on the fact that arsenic concentrations found in soil samples collected from these borings exceeded Reportable Concentrations, and additional sources of contamination were discovered as the SI field activities were completed.

## 6.3 RECOMMENDATIONS

Based on the results of the SI conducted, the following recommendations are presented:

1. Determine background concentration of metals in soil at the site. Background boring 01-001BH exceeded the MADEP Reportable Concentrations for arsenic. Background boring 01-002BH was located in the area of contamination from USTs.

2. Conduct a Remedial Investigation/Feasibility Study (RI/FS) at the site. SVOC, metals and TPH contamination is present at the site, and the areal extent has not been determined.

3. Determine the areal extent of contamination at the USTs and oil/water separator/dry well areas. Contamination has been reported to be present in the area of the USTs and oil/water separator/dry well.

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